Agricultural Research Institute

PUSA

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 1, 1909

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE AND THE PRACTICAL PROBLEMS OF THE FUTURE[1]

THE end of the world has long been a favorite subject of speculation. The ancients and our forefathers of the middle ages were pleased to imagine some sudden final disaster; as by fire. Science in our own day furnishes a basis for a more definite forecast. Sudden catastrophe is still by no means precluded, for astronomers have occasionally witnessed outbursts in other regions of the universe which may have produced profound changes throughout neighborhoods like our solar system and have brought to some tragic end life on planets like the earth.

With the development of the doctrine of energy has come the conviction of an end of the world; inevitable, as the death of the individual is inevitable. In neither case, however, is longevity to be regarded as necessarily beyond human control. Biologists are beginning to intimate, and it would seem with growing confidence, the possibility, remote but thinkable, of a considerable extension of the term of bodily life. Equally conceivable is it that the race, if it become sufficiently wise before old age overtakes it, may so modify and control the conditions of life as to greatly prolong its career.

We do not need to consider a conceivable end by cosmic catastrophe any more than

[1] Address of the retiring president of the American Association for the Advancement of Science, Baltimore, 1908.

the individual in estimating the number of years that he may reasonably hope to live would take into account death by lightning—were that the only death, he might look forward to a very long life. Neither need we consider the accuracy of the forecasts of the probable future of the sun anymore than the individual takes into account probable geological and climatic changes as having any bearing on his own expectancy of life. The drama of human existence on the earth is a fleeting show when measured in terms of the duration of the sun. The exhaustion of our supply of fixed nitrogen, a contingency discussed some years ago by Sir William Crookes, and of our free oxygen which was more recently suggested by Lord Kelvin are factors that bring the question of the duration of human activity somewhat nearer home but they are still so remote as to be of no immediate practical importance. Other factors there are, however, that are not only immediate but rapidly becoming imminent and pressing.

At the recent conference on the conversation of resources which met at the White House at the invitation of the president of the United States notes of warning were sounded concerning the coming exhaustion of coal, wood, ores and soils. Whether or not we accept as exact the estimates furnished by experts on that impressive occasion, there is no doubt that we are approaching the end of our available resources and that the near future will have momentous problems to face.

Certain things are clear.

First. Unchecked wastefulness as exhibited, for example, in the extermination of the bison, in the destruction of forests, in the exhaustion of the soil, in the disappearance from our coasts and streams, that once teemed with fish, of this important source of food supply, in the pouring into the air of an incredible amount of unused fuel from hundreds of thousands of coke ovens must cease or our ruthless exploitation will bring disaster on generations soon to come. The prevention of these and countless other manifestations of individual and corporate greed is a problem for the economist and the law-maker although they will scarcely succeed in its solution without calling science to their aid.

Second. Saving and thrift offer at best only a postponement of the day of distress. The end of our supplies of coal and petroleum must ultimately be reached. Forests may be renewed and the soil restored to its maximum fertility but the problem which is presently to confront the race is that of civilized existence without recourse to energy stored by the slow processes of nature. This problem must be definitely solved before the complete exhaustion of our inherited capital.

Third. The problem is not without conceivable solution, since the annual accession of energy from the sun, did we know how to utilize it without awaiting the slow processes of storage employed by nature, is ample for every thinkable need of the future inhabitants of our planet. Estimates of the constant of solar radiation show that about 2.18 kilowatts of power is continually received from the sun for every square meter of the earth's surface or over seven and a half millions of horsepower per square mile. The present use of power in the United States is about eighty million horse-power or one horsepower per capita. This quantity is likely to increase more rapidly than the population in the future unless curtailed by lack of fuel, but it is evident that a very small fraction of the sun's radiation would meet all demands.

Now abundant power is soon to be the factor upon which material advancement will chiefly depend. To obtain it in the

face of the disappearance of coal and petroleum will be imperative. For success in this, upon which in the immediate future the welfare of the race and ultimately its very perpetuity is to depend, we must look to science. Mere ingenuity or inventiveness, however widely developed, will not suffice. The inventor and the engineer can but utilize and apply the material which the man of science provides and with the exhaustion of our stores of scientific knowledge civilization must halt.

It is of this fundamental relation of science to the progress of our civilization that I wish to speak. The fact that material progress is based upon science seems to be but dimly understood. It appears to be generally supposed that it is to the inventor and to those who use his devices that we owe our present advantages over our forefathers. I would not belittle the achievements of the so-called practical man, but the public must be taught that application can never run ahead of the knowledge to be applied and that the only road to higher achievement in practical things is by the further development of pure science.

The *main product* of science, using that word in its broadest sense, is *knowledge;* among its by-products are the technological arts, including invention, engineering in all its branches and modern industry. Not all industries have attained the character of a technological art. Burning the woods to drive out game and thus obtain a dinner, is a form of industry. Like it in character are some very large industries, such as agriculture of the sort that impoverishes the soil; lumbering that destroys forests and incidentally ruins rivers and increases erosion; coke making by processes that waste forty per cent. of the energy of coal. The production of power from coal by means of the steam boiler and the reciprocating engine we at present regard as a highly developed technological art; yet it is a process which at the very best converts less than ten per cent. of the total stored energy of the fuel into available form. If the ultimate purpose of this power is the production of light, we by our present methods suffer a second waste of ninety per cent. or more, so that the efficiency of the combined processes is but a fraction of one per cent. These things are excusable while ignorance lasts. They become criminal with realization of the results and are inconceivable in a community of fully developed civilization. Science paves the way for the gradual supplanting of these barbarous methods by more refined and rational processes, but they often persist long after they are known to be injurious to the public welfare because they happen to serve some selfish individual or corporate purpose. In such cases it is to science again that we must look for the development of an enlightened public opinion that will end them.

Nearly all really important technical advances have their origin in communities where the great fundamental sciences are most extensively and successfully cultivated. In the field of artificial illumination, to take a concrete example, each successive improvement over the tallow-dips and whale-oil lamps of our ancestors has come to us from over the water.

The first building to be lighted by coal-gas was the chemical laboratory at Würtzburg (1789). Illuminating oils were being made from petroleum by Binney and Young, in England (1850), at a time when we were bottling our crude oil and selling it for liniment.

During the later years of the nineteenth century occurred the sudden development of arc-lighting in this country; a change from darkness to light unprecedented and almost unimaginable. This magical transformation from conditions but little re-

moved from medieval darkness was largely due to the ingenuity of Farmer, Brush, Elihu Thomson, Weston and numerous other American inventors, backed by an energetic people keen to adopt whatever appeals to them. The electric arc, however, was discovered by Sir Humphry Davy (1806). It was the development of the voltaic battery by Grove and Bunsen (1840) that gave the first impetus to electric lighting, and of the dynamo by Gramme and Siemens that made it a commercial possibility. Arc lamps had been in regular use in the lighthouses of England and France since 1858; a factory in Paris was thus illuminated in 1873; widespread public interest in arc-lighting was first kindled by the dazzling display at the Paris exposition of 1878.

Lighting by glow-lamps, like arc-lighting, had its first great growth in America. Nine years after Edison's announcement of his plan of installing high-resistance lamps in multiple in a constant potential circuit, and his public demonstrations at Menlo Park of the practicability of the scheme, over three million such lamps were in use in the United States.[2] The incandescent lamp, however, with the essential feature of a carbon filament in vacuo, seems to have originated, although not yet in practicable form, with Swan in England some years previous to 1879.[3]

To Auer von Welsbach, Nernst and Bremer, in Germany, we owe the use of the oxides of the rare earths as illuminants; to Arons, of Berlin, the mercury arc in its original form; to various inventors and experimenters across the water the new filaments of tantalum, tungsten and other refractory metals that are rapidly replacing our filaments of carbon. The Pintsch gas which lights our railroad trains is likewise a German invention.

[2] T. C. Martin, *Electrical World*, Vol. IX., p. 50.

[3] Dredge, "Electric Illumination."

In the matter of acetylene, although priority for its commercial production was awarded to Wilson in Canada, the process historically considered is obviously traceable to the scientific researches with the electric furnace at the hands of Moissan in France. The absorption of acetylene by acetone, which makes storage in portable form of that brilliant illuminant practicable, is likewise a European idea.

This summary of facts does not display an exceptional, but a prevalent, condition. It might be duplicated in almost any department of technology. Although we in this country have had a hand in the development of the art of generating power nearly every important step in the use of steam originated in Europe, as did most of the devices pertaining to boilers and engines; such as gauges, injectors, governors, condensers and the like. This is not strange, in the case of the reciprocating engine, which is an old-fashioned machine, a relic, the continued use of which is due chiefly to the extraordinary tendency of the race to cling to the things of the past. It is true, however, to no less extent of the invention of internal combustion engines, steam turbines, water turbines and of the whole family of electrical devices for the transmission of power. Generator and motor, transformer and storage battery alike had their inception overseas. It is the same in artificial refrigeration, in telegraphy, in photography; indeed, in nearly all the arts that are based upon the fundamental science of physics. In the great fields of industrial chemistry, especially, European preeminence is universally admitted.

All this does not mean that we do not deserve our popular reputation as an ingenious people, facile and versatile, quick to grasp and put to use any novelty. Nowhere else in the world has cunningly de-

vised and admirably designed machinery been made to supplement and supplant hand labor so successfully; we have indeed a passion and a genius for invention. But it is one thing to contrive clever mechanical combinations based upon simple principles long since established and familiar in every machine shop and quite another to possess the combination of profound chemical knowledge and technical skill that have yielded such extraordinary results in the glass works at Jena, or the mathematical ability to develop the theory of lenses to the point which has made it possible to design the wonderful optical instruments that have made the same little German town famous.

Many inventions that did not originate with us have found their widest field in this country. Many foreign ideas have first obtained practical form for general purposes here. We were among the first and continue to be by far the most extensive users of the electric railway. In Davenport, Page, Farmer, Green and others we count pioneers of the predynamic period worthy to be named with Davidson, Pinkus, Jacoby, Bessolo and other European inventors of their day. Nevertheless it was Pacinotti, Gramme and Siemens who gave us the electric motor; it was at Sermaize in France that the classical experiment of plowing by electricity was performed; it was at the industrial exhibition in Berlin, in 1879, that the first electric road in the modern sense was operated. The first roads for ordinary everyday public service were the Berlin-Lichterfelde Line and the Port Rush Electric Railway, in Ireland, a third-rail system supplied with water-power. Budapest had the first successful underground trolley road. The most advanced type of electric traction by the use of alternating currents, as exemplified in Switzerland, northern Italy and elsewhere has only very recently received serious attention in this country.

We transmit a larger amount of energy over greater distances and at higher voltages than any other people, but the practical possibility of such transmission was first exemplified by the sending of power from the waterfalls at Laufen 100 kilometers away, to the electrical exhibition at Frankfort-on-Main, in 1892.

It is not a question of American *versus* European skill, but of the conditions under which useful applications are likely to originate. The history of technology shows the essential condition to be scientific productiveness.

A country that has many investigators will have many inventors also. A scientific atmosphere dense enough to permeate the masses brings proper suggestions to many practically inclined minds. Where science is there will its by-product, technology, be also. Communities having the most thorough fundamental knowledge of pure science will show the greatest output of really practical inventions. Peoples who get their knowledge at second-hand must be content to follow. Where sound scientific conceptions are the common property of a nation the wasteful efforts of the half-informed will be least prevalent. The search after perpetual motion, the attempt to evade the second law of thermodynamics and the promotion of the impracticable are all simply symptoms of a people's ignorance.

Modern invention is a very near neighbor to the pure science of the laboratory and the relation becomes daily more intimate. Nothing could apparently be more academic in its early development or further from the practical workaday world than the subject of electric waves. For years it was regarded as a fine field for the speculations of the mathematical physicist. Then at the hands of Hertz and his

followers it became a fascinating topic for experimental investigation by men devoted to science for its own sake. Suddenly it was launched into the realm of hard-headed commercialism by a practical man, daring, enthusiastic and optimistic enough, at a time when electric waves could be produced in one room of the laboratory and detected in the next room, to dream of sending such waves across the sea as bearers of human messages.

At every step of its development the things that have made wireless telegraphy possible have been borrowed from pure science.

While Marconi was still struggling to adapt the apparatus of Righi to long-distance transmission the antenna and the coherer were already in use by Popoff[4] in the study of oscillatory lightning. In the thermal detector of Fessenden the almost invisible platinum wires produced years before by Wollaston for the cross-hairs of telescopes appear in a new field of usefulness. The "lead-tree" familiar as a simple and beautiful lecture experiment in electrolysis forms the basis of the responder of DeForest. Another form of electrolytic detector introduced independently as the receiver of wireless signals by Schloemilch and by Vreeland traces back to the Wehnelt interrupter. Marconi's latest receiver, the magnetic detector, is an ingenious modification of Rutherford's device for the study of electric waves and this in turn was based on the classical experiment of Joseph Henry on the effects of the discharge of Leyden jars on the magnetization of steel sewing needles.

It is needless to multiply examples. In the history of science and of invention this intimate relation appears to be almost universal.

In this country science is making a great growth, particularly in material equipment. The number and size of our special societies is increasing year by year. The American Association for the Advancement of Science has already a membership of more than 6,000. Our scientific journals are steadily growing in influence and importance. Colleges everywhere are building laboratories and the universities are increasing their facilities for research. The federal and state governments are beginning to recognize the necessity for scientific investigation and to foster it.

Nevertheless there is much to be done to bring us up to the European standard. Our position is like that which exists in agriculture. The total product of wheat and corn is enormous, but when we consider bushels per acre we realize the superiority of the intensive cultivation of older countries. In science likewise our total output is creditable, but our specific productiveness is still low. The discrepancy can hardly be ascribed to inferiority of intellect or to lack of industry, for we are of the same stock as those who have created modern science and who have given it its high place in other countries. For an explanation we must look, rather, to environment and to the conditions under which scientific work is done here and abroad.

Now the environment of science has always been academic. Science has its home in the university. From Galileo and Newton to our own time the men who have laid the foundations upon which civilization is built have nearly all been teachers and professors.

A few notable exceptions there are, such as Darwin, whose centenary we are about to celebrate. Each branch has its short list of unattached investigators—Franklin, Rumford, Carnot, Joule in physics, etc., but the honor-roll of science is essentially an academic list.

[4] Popoff, *Journal of the Russian Physical Chemical Society*, Vols. 28 and 29, 1895.

It is so in America as elsewhere, but abroad the dictum of the university is authoritative; with us the term *academic* is one of contempt. European practise is confidently based on theory, but in America men of affairs habitually use the word *theoretical* as synonymous with impracticable, unworkable and not in accordance with fact.

It is necessary, therefore, in considering the place of America in science, to contrast the standing of our educational institutions, not pedagogically, but as centers of research, with those of our neighbors. I attempt no general comparison but offer only a single simple illustration drawn from the one branch of science for which I feel competent to speak: Holland has but four universities, with less than four thousand students in all. There are in this country at least fifty institutions larger and better equipped on the average than the Dutch universities. If we were on a par with Holland in physics, for example, we should have seventy or more university teachers, who were, at the same time, investigators of the rank of Lorentz, Zeeman, Julius, Ohnes, Haga and Van der Waals. I shall not venture into other sciences, but leave my colleagues to make their own comparisons.

We have less than our share of men of science because we have not, as yet, universities that sufficiently foster and encourage research. When in any of our institutions a man distinguishes himself by productive work he is frequently made a dean, director or even president, and is thus retired from what might have been a great career as an investigator. Thereafter he is compelled to devote himself to administrative duties, which some one not equipped for the important task of adding to the world's stock of knowledge might just as well perform. It is as though the authorities were to say: *X* has written an admirable book; we must appoint him bookkeeper—or *Y* is developing a decided genius for landscape; we will increase his salary and ask him to devote all his time to painting the woodwork of the university buildings. Nor does the mischief stop with the sacrifice of a few bright spirits. It extends to the bottom. The head of each department is a petty dean, cumbered with administrative detail. He is expected to hold every one under him to account, not for scholarly productiveness, but for the things which chiefly hinder it.

In this exaltation of administrative ability over creative gifts which are much rarer and more precious, our institutions share the weakness which pervades our industrial establishments where the manager or superintendent usually gets larger pay and is regarded as more important than the most expert craftsman. In both we see the same striving for a certain sort of efficiency and economy of operation and for the attainment of a completely standardized product. This tends in both cases to the elimination of individuality and to sterility. In the university it retards instead of developing research. In industry it discourages originality. I would that there might be displayed in the administrative offices of every institution of higher education this testy remark once made by an eminent scholar: *"You can not run a university as you would a saw-mill!"*

If any one questions the responsibility of the American university for the shortcomings of American science and is inclined to seek some more obscure cause for the conditions that I have endeavored to portray, let him consider the history of astronomy in this country. This science for some reason was from the first accorded favors not vouchsafed to any other branch of learning. Colleges that made no pretence of research and had neither laboratories nor libraries worthy of the name were

ambitious to have observatories, and rich men were found to establish and endow them. The observatory implied, somehow, to the minds of the authorities, an astronomer—not merely some one of good moral character who could teach the subject—and so it came about that there was one member of the college faculty who was expected to do scientific work and was left comparatively free to observe and investigate. Modest as most of these early provisions for astronomy were, they bore fruit, and American astronomy gained standing and recognition while her sister sciences were struggling for existence. Later, it is true, there arose an ambition for laboratories and there were laboratories; but unfortunately, save in very rare instances, the laboratory has not implied an investigator. The conditions which made astronomy what it was have not been repeated. Productiveness has not been demanded nor expected; neither have the inmates of our laboratories been accorded that exemption from excessive pedagogical duties which would enable them to give their best strength to research. Were it otherwise I should not now be reminding you sadly of these deplorable *home-conditions* of our sciences, but singing their achievements.

A recent event in the educational world well illustrates the weakness of our academic attitude toward science. The head of one of our strongest, most modern, most progressive and best equipped institutions has announced, as one of the details of a noble bequest to the university, the endowment of ten research professorships.[5]

President Van Hise declares:

The provisions for their support, including liberal salaries, assistants, materials, a limited amount of instructional work, and relations with students, are an epitome of the situation in the best German universities, which are admitted to stand first among the institutions of the world in the advancement of knowledge.

This is indeed an event to warm the heart of every one who is interested in the promotion of science. All who are devoted to learning for its own sake or who realize the importance of science to the welfare of the nation will applaud that portion of the will in which this great gift is made, which reads:

The university may best be raised to the highest excellence as a seat of learning and education by abundant support in pushing the confines of knowledge.

And yet in very truth there is nothing to prevent the University of Wisconsin, or any other of a hundred of our institutions, without awaiting the rare advent of some far-sighted benefactor, from having, not ten, but all her professorships made research professorships—nothing, alas, but the deep-seated and seemingly uneradicable conviction of our boards of control, that the endowments committed to their charge are for some other purpose.

A true university from the standpoint of scientific productiveness is a body of scholars; that is to say, of men devoting themselves solely to the advancement of learning. Every one in it from top to bottom should be an investigator. The entire income of a university should be expended in the promotion of science, *i. e.*, of knowledge. Teaching is a necessary factor in the advancement of learning and so a function of the university. University teaching should be done by investigators not only because more investigators are to be developed, but because the promotion of science, on the scale which the future demands, means that science shall not remain narrowly academic, but shall more and more pervade the life of the people.

From the standpoint of American institutions such a definition of the university

[5] "Memorial Exercises in Honor of William F. Vilas," Science, XXVIII., October 30, 1908, p. 601.

is revolutionary, but it can not be said to be impracticable or Utopian; for upon precisely such ideals the most successful university systems in the world have been built.

That this type will bear transplanting to American soil was triumphantly demonstrated in the work of Daniel C. Gilman, who gave the Johns Hopkins University at its inception the essential characteristics of the German universities as regards research. This successful experiment should have marked an epoch in the history of higher education, but a generation has passed and we have not as yet a university system devoted primarily to the advancement of learning. We still consider investigation merely as a desirable adjunct to university activities: never as the thing for which the university exists.

Germany, on the other hand, has for a century consistently developed the university as a center of research and through the promotion of pure science in the university has made German civilization what it is to-day.

I would not be understood as urging German or other European methods in all details upon a country where quite different conditions exist but one general principle is of universal application. In whatever we have to do, whether it be municipal administration, sanitation, road-making, the construction of water-ways, the development of industries, or the conservation of natural resources, the fullest and latest scientific knowledge should be utilized. Practise should not be permitted to lag indefinitely behind theory and that they may go hand in hand public work and private enterprises should be in the hands of *those who know*. At the same time science should be persistently advanced by every possible agency.

As American men of science we should demand for America also universities whose purpose is the production of knowledge. There are those who will reply to such a demand that we need not look abroad; that we are already developing an educational system better for our purposes than any that has hitherto existed. So be it, but whatever pedagogical experiments we may choose to try, science and the advancement of learning must not be forever sacrificed to them. *We need not merely research in the universities but universities for research.*

To my mind the future of science in America as elsewhere is essentially a question of the future of the universities. It is conceivable that our institutions may so long continue blind to their chief function as to be supplanted by some new agency called into existence to take up their neglected work. Already great endowments for the promotion of research quite without any pedagogical feature, have come into existence. For all such science has need and will have increasing need as our situation becomes more acute and we are brought closer to the great crisis.

But it will be found that the conditions for maximum scientific productiveness are precisely those which would exist in the ideal university. All attempts at a machine-made science are doomed to failure. Science-making syndicates are likely to meet ship-wreck on the very rocks on which our American educational system is already aground. No autocratic organization is favorable to the development of the scientific spirit. No institution after the commercial models of to-day is likely to be generously fertile. You can contract for a bridge, according to specifications. If a railway is to be built and operated a highly organized staff with superintendents and foremen and an elaborate system reaching every detail may be made to yield the desired results. No one, however, can draw up specifications for a scientific dis-

covery. No one can contract to deliver it on a specified day for a specified price. No employee can be hired to produce it in return for wages received.

To the investigator the considerations I have endeavored to present are unimportant. Science for its own sake is his sufficient incentive; but it is all important for the community at large to realize that no real addition to knowledge is useless or trivial; that progress depends on scientific productiveness; that science, which must be fostered if we are to continue to prosper, is a republic whose watchwords are *liberty, equality, fraternity.*

World power in the near future is to be a question of knowledge—not of battleships—and what is now spent on armaments is to be devoted to its pursuit.

Beyond lies that future in which it will no longer be a question of supremacy among nations but of whether the race is to maintain its foothold on the earth. For that great struggle we shall need knowledge, and ever more knowledge, and it is high time that we should prepare for war in these days of peace and plenty.

EDWARD L. NICHOLS

CORNELL UNIVERSITY,
December 14, 1908

UNIVERSITY REGISTRATION STATISTICS

II.

Taking up the registration at the universities in order, we find that the *University of California* shows an increase of 75 in the graduate school, of 96 in the undergraduate body in arts, science and engineering, and of 77 in the professional schools. In arts there are 79 more men and 43 fewer women, a net gain of 36. The enrollment in the summer session exhibits an increase of 228 over 1907. The 95 students registered in law are enrolled in the Hastings College of the Law in San Francisco. Besides these there are 24 seniors and 17 graduate students in jurisprudence at Berkeley, of whom a considerable number are candidates for the degree of *juris doctor,* these 41 students thus in reality constituting a graduate school of law. Of the extension students about 750 are enrolled in San Francisco, about 150 in Stockton, and about 250 in Sonoı , and there are other centers in process of organization. Mr. James Sutton, recorder of the faculties, reports as follows:

Professor Eugene W. Hilgard, who was called to the University of California as professor of agriculture in 1874, has retired from the active work of the department, and Professor Edward J. Wickson becomes professor of agriculture and director of the agricultural experiment stations. Professor Frank Soulé, who became a member of the faculty in 1869, has been appointed professor of civil engineering, emeritus, and has been succeeded as the head of the department of civil engineering by Professor Charles Derleth, Jr., formerly associate professor of structural engineering. The regents have established a professorship of psychology, and have appointed thereto Professor George M. Stratton, who since 1904 has been professor of experimental psychology at Johns Hopkins. Another chair established during the year was that of professor of agricultural practise and superintendent of farm schools. The first appointee is Leroy Anderson, formerly of Cornell University. To the chair of Romanic languages, which has been vacant for several years, the regents have appointed Professor William Albert Nitze, until recently professor of Romance languages in Amherst College. The department of Semitic languages suffered grievous loss in the death, on April 27, 1908, of its founder and head, Dr. Jacob Voorsanger. Assistant Professor William Popper is in charge of the work of the department.

Plans have been prepared for the Boalt Memorial Hall of Law. Mrs. Boalt's original gift was $100,000, but members of the California bar have pledged an additional $50,000 to complete the building. In addition, there is available a considerable fund for a law library. Construction work upon the new Doe library is well advanced. Present plans contemplate the completion immediately of the northern part of the building, which will amply allow for library needs for several years to come. The amount available at the

present time for construction is $575,000. The building now under way will contain a main reading-room with accommodations for 400 readers and several smaller reading-rooms. There will be 29 seminar-rooms, 2 class-rooms, besides the usual administrative departments of a large library. The book stacks will have a capacity of 300,000 volumes and will be capable of extension indefinitely. As an annex to the agricultural building, there has recently been erected the so-called fertilizer control laboratory. The work of this laboratory is of immense importance to agriculture and horticulture in California. A building for the departments of hygiene and pathology is under construction near the Rudolph Spreckels physiological laboratory. The frame building which houses the department of architecture has been enlarged this year to three times its former capacity. On the university farm, at Davis, there have been erected a creamery, a live stock judging pavilion, and several cottages for the members of the staff. In addition, contracts have been let for a dairy barn and sewer system. The university has begun the erection of a galvanized iron temporary building as a museum of vertebrate zoology. The collection of representative specimens of Californian vertebrate fauna will be immediately begun under the direction of Mr. Joseph Grinnell. Miss Annie M. Alexander, of Oakland, has agreed to give to the university the sum of $7,000 yearly for seven years to equip and maintain the museum.

The Massachusetts Association for the relief of California, organized shortly after the great earthquake and fire of 1906, has remitted to the San Francisco Relief and Red Cross funds (incorporated) the sum of $100,000, being the balance of the relief funds in the hands of the Massachusetts Association upon the completion of the active work of relief. In accordance with the recommendation of the Massachusetts Association, this money has been paid over to the regents of the University of California for the university hospital in San Francisco, provided that the hospital shall always maintain at least ten free beds to be known as the Massachusetts beds and a ward to be known as the Massachusetts ward. In the assignment of these beds the university is to give preference to deserving sufferers of the disaster of April 18, 1906.

Last year we reported the installation of the Bancroft library of American history and the transfer of this collection to the library of the newly organized Academy of Pacific Coast History, in one of the university buildings at Berkeley. Very soon after the Bancroft collection was brought to the university, the "lost Carondelet papers" were discovered among the miscellaneous manuscripts of the collection. Baron de Carondelet was the last Spanish governor of Louisiana, and historians have long known that his papers must be in existence somewhere. An eminent historian has declared that the discovery of these papers will necessitate the rewriting of the history of the southwest.

Perhaps the most unusual gift ever made to the university was that received by President Wheeler on Friday, September 25. On that evening a stranger called at Dr. Wheeler's house, saying that he was a messenger from a man "up in the woods" who wished to "grubstake" some student who was working his way and needed a little money to help him finish his college course. The stranger then delivered a small sack containing $349 in coin. The amount had been $350, but one dollar had been allowed the messenger for delivering the money. No clew to the identity of the donor could be obtained. The gift will be known as the Grubstake Loan Fund.

The *University of Chicago* shows a gain of 242 in the fall and of 414 in the summer enrollment, or one of 520 in the grand total for the year, 540 summer students having returned for work this fall, as against only 404 last year. The greatest gain in the fall registration, one of 167, is found under "other courses," which embrace those given for teachers afternoons, evenings and Saturdays. There is a loss of 15 men in the college, which is offset by a gain of 17 women. The professional and graduate schools all exhibit a small increase.

The enrollment of *Columbia University* shows a highly gratifying increase in all departments. The total registration represents a gain of almost 500 students over last year, of which over 80 per cent. can be credited to the fall registration. The grand total this fall exceeds that of two years ago by over 1,000 students, a growth of 22 per cent. in that brief interval. Both Columbia and Barnard colleges (arts, men and women, respectively) show a sub-

stantial increase over last year's figures, the entering class being the largest in the history of each institution. The non-professional graduate schools of political science, philosophy and pure science, taken as a whole, continue to share in the general growth of the university, although the faculty of philosophy has experienced a slight loss, no doubt owing to the establishment this fall of free courses for teachers by the College of the City of New York. The total enrollment of graduate students, including those with their major subject in education—primarily registered at Teachers College—is 958, as against 938 in 1907 and 513 in 1902. The professional schools, without exception, have made encouraging gains in attendance, the schools of mines, engineering and chemistry having recorded the largest increase in actual number of students, namely, one of 92, whereas the largest percentage gain has been registered by the school of law, namely, one of almost 30 per cent.; the entering class in the medical school shows a growth of no less than 40 per cent., while pharmacy has gained 55 students. Including students from the college registered in the professional schools, the total enrollment of these schools is as follows: Law, 346; medicine, 318, and mines, engineering and chemistry, 699. The almost phenomenal development of Teachers College continues without interruption, there being 950 students enrolled this year, as against 563 in 1902. The two residence halls for men are practically filled this year, and the erection of a third dormitory for men has become a need sooner than even the most optimistic anticipated. The summer session was even larger than that of the preceding year, the total attendance being 1,532, as against 643 in 1902, 34 of the students being registered at the medical school in 1908. The 655 officers are exclusive of 87 instructors in the Horace Mann and Speyer Schools, as well as of the summer session staff. In 1906 there were 571 officers. The extension work continues to make satisfactory progress, the evening technical courses established the winter before last attracting many students.

The domestic economy building in process of erection at Teachers College should be ready for occupancy before the close of the year, whereas work has been temporarily discontinued on Kent Hall, the new building for the schools of law and political science.

The incumbent of the Kaiser Wilhelm professorship this year is Professor Albrecht Penck, of the University of Berlin, whose subject is physiography, Professor Felix Adler, of the Columbia department of philosophy, being the third incumbent of the Theodore Roosevelt professorship at the University of Berlin. President Benjamin Ide Wheeler, of the University of California, has been selected by the trustees as the Theodore Roosevelt professor for 1909–10.

The sum total of the gifts received in money during the year is $329,385.39, while the grand total of such gifts received in the last seven years is $10,286,296.58. The total outstanding debt of the university is $3,489,156.45; the income for 1907–8 amounted to $1,960,258.40, and the annual budget for 1908–9 provides for the expenditure of almost two million dollars.

An amendment to the statutes was adopted by the trustees on February 3, 1908, which provides that "each professor and adjunct professor shall be entitled, once in every seven years, to a leave of absence of one year on half pay, or to a leave of absence of one half year on full pay, such period of absence to count as service to the university." This provision renders it possible for those officers who

can not live for a year upon half of their present salaries to secure eight months' absence once in seven years on full salary. During the year the statutes were also amended in order to establish the new grade of associate, ranking below the grade of adjunct professor and above that of instructor. It is to be employed "in the case of an officer of instruction who is not expected to devote the greater part of his time to the service of the university, but to give statedly a limited amount of instruction upon a special subject."

A system of academic advisers was put in operation in Columbia College last spring, "by the terms of which each undergraduate student is assigned to the oversight and care of an officer of instruction, who becomes his guide and friend as well as his teacher. By frequent personal meetings and conferences, it is the duty of the adviser to keep himself closely informed of the progress and academic life of each of the small group of students assigned to him and to give to such students the counsel and direction which they need, not only in regard to their studies but in regard to all phases of their undergraduate activity and life."

The requirements for admission to the medical school were recently revised, "so that, from and after July 1, 1910, the minimum requirement will be the completion of not less than two full years of study in an approved college or scientific school, which course must have included instruction in the elements of physics, in organic chemistry and in biology."

Cornell University reports a gain of 407 in the grand total, to which the fall enrollment has contributed 368, the summer session showing an increase of 86 in actual number of students. All of the faculties have experienced an increase this fall with the exception of medicine, where increased standards for admission have resulted in a reduction of the attendance by 109. The academic registration and the engineering enrollment both show a gain of 94 students, agriculture one of 69, architecture of 30, law of 23, the graduate school of 41. The students listed under "other courses" are taking the short winter course in agriculture, and there are 114 more of these than there were last year. Of the 1,727 engineering students, 1,158 are registered under mechanical and 569 under civil engineering.

Harvard University's grand total is to all intents and purposes equal to that of last year, but there has been a loss of 37 in the total fall enrollment. The loss of 37 men in the college is offset by a gain of 34 women in Radcliffe, the scientific school suffered a decrease for the reason explained in full last year, the law school has lost 26 students, the graduate school of arts and sciences has gained 18, while medicine, dentistry and divinity have remained practically stationary. The summer session of 1908 was larger by 224 students than that of the previous year, and there has been a gain of 61 in the number of instructors. Of the extension students, 1,119 are registered in courses offered at the Lowell Institute by Harvard instructors, and in the case of qualified candidates, counting towards a Harvard degree.

The new graduate school of business administration attracted 56 students; it furnishes a two-years' course leading to the degree of master in business administration. The Bussey Institution has ceased to exist as an undergraduate department for instruction in practical agriculture, the Bussey fund being now devoted to advanced instruction in problems relating to agriculture, such as economic entomology, animal heredity, experimental plant morphology and comparative pathology of animals.

The *University of Illinois* shows consistent gains in every department, with the exception of music, where there has been a loss of 24 students, of library science ("other courses"), which reports a loss of 10 students, of art, where the registration has been reduced from 10 to 4, and of law, where the registration shows a falling off of 3 students. The largest gain, one of 68, is in the graduate school, while medicine has gained 48, and the male academic and commerce each 37. Architecture, pharmacy and dentistry have also gained over 30 students each. The total increase in the fall enrollment amounts to 247 students, while the summer session was larger by 101 students than that of 1907. Owing to the fact that the percentage of summer-session students who returned for work in the fall was considerably greater in 1908 than in the year preceding, the gain in the grand total over last year is only 228. The total registration in 1903 was 3,239, as against 4,400 this year, a gain of 35 per cent. in five years.

The distribution of students by faculties under *Indiana University* is somewhat different from what it was last year, and it is consequently difficult to make accurate comparisons. The loss in law and the gain in medicine have been explained above. There are 9 more women in the academic department than there were last year, while a loss of 66 students in the graduate school is more than offset by a gain of 122 men in the college, but this may be due to the inclusion this year of a number of graduate students in the academic department. The total increase in the fall enrollment is 192, and the summer session exhibits a gain of 284, the growth in the grand total being one of 446.

The *State University of Iowa* exhibits an increase in every department except that of dentistry, which reports a loss of 16 students, and those of medicine and music, where the enrollment has remained stationary. The largest gain is in the academic department, namely, one of 85 men and 60 women, whereas the scientific schools have only two more students than last year. Pharmacy has gained 14, law 10, the graduate school 11, and the nurses' training schools (other courses) 9, the increase in the entire fall registration being one of 158 and in the grand total for the year one of 168, the summer session of 1908 having been slightly larger than that of the preceding year. In the fall of 1903 there were only 1,260 students registered at Iowa, as against 2,356 this year.

The standards of admission to the law school were raised this fall, inasmuch as no students were permitted to enter who did not present the entire thirty credits or fifteen units, whereas in previous years students were admitted with deficiencies aggregating three credits. Beginning with September, 1909, one full year of college work, in addition to the four years of high school work formerly required, will be demanded for admission to the school of medicine, and beginning with September, 1910, the requirement will be still further increased to two years of college work. Beginning with September, 1909, the requirements for admission to the college of dentistry will be advanced to four years of high-school work. No other changes in the standards of admission to the several schools of the university are in immediate contemplation.

The university has completed during the past year an extension to the engineering building at a cost of about $75,000. The extension duplicates the capacity of the building, and completes the first wing of the engineering quadrangle. A building for the law school is now being erected. This building will cost $125,000, and will be completed in about a year. Both of the buildings mentioned are of Bedford stone, fireproof construction, in accordance with the general plan of the

regents, and in their location the regents have followed the plan of the ultimate campus, which has been prepared by landscape architects.

Johns Hopkins University has gained 47 students since last year, of whom 30 are found in medicine and 17 in the graduate school, the academic department having remained stationary. In 1902 there were 162 students in the college (166 in 1908), 329 in medicine (1908: 355) and 179 in the graduate school (1908: 177).

The scientific schools (— 10), medicine (— 9) and art (— 3) have suffered slight losses at the *University of Kansas*, which are much more than offset by gains in the other departments, the academic department alone contributing an increase of 106 students—77 women and 29 men. Law has gained 22, music 19, pharmacy 8 and the graduate school 12, the total increase in the fall registration being 108. The summer session enrolled 89 students more than that of 1907, the increase in the grand total being one of 154 students.

The *University of Michigan* reports an increase in the fall registration of 148 students, law alone exhibiting a loss (41 students), while medicine has remained uniform. The academic department has registered a net gain of 45, this figure representing an increase of 47 men and a decrease of two women. The graduate school has gained 65 students, the scientific schools 28, dentistry 23 and pharmacy 7. The summer session was slightly larger than that of the preceding year, but the number of those enrolled both in the summer term and the regular college year was considerably smaller, resulting in an increase in the grand total of 235 students. The attendance at Michigan passed the five-thousand mark for the first time this year, it having reached 4,000 in 1904. Mr. Shirley W. Smith, secretary of the university, has submitted the following items of general interest:

The session of the summer of 1908 for the academic department was for the first time in our experience fixed at eight weeks instead of six, and the fee was raised from $15 to $20. The fact that this change was followed by an increase in attendance of thirteen per cent., which increase was largely made up of those not enrolled in the regular session, is interesting as showing the demand by teachers for the largest opportunity for actual summer work.

Our engineering faculty have made provision for a six-year course, by the completion of which students will secure a broader foundation of general culture and larger technical attainments. We shall look forward with interest to see whether these increased opportunities will meet a real demand in the education of young men preparing for the active life of to-day.

In our law department we have sought to encourage and to recognize the superior equipment of those who combine academic with legal training, and have established the degree of J.D. (*juris doctor*) to be conferred upon certain college graduates completing the full three years' law course. The age of admission to the first year class of the law department has been raised from eighteen to nineteen years, with a corresponding higher age requirement for the two upper classes.

In the material equipment, our most important additions are as follows: An extensive addition has been made to the observatory building, including a new dome 40 feet in diameter. We are installing a large reflecting telescope which is now approaching completion. This instrument has been designed especially for photographic and spectroscopic work, and it is arranged for use either as a Newtonian or as a Cassegrain reflector. When used in the latter manner, the mirrors give a three-fold magnification with an equivalent focal length of 60 feet.—We have acquired by gift of an alumnus and from the city of Ann Arbor a tract of land of about ninety acres to serve as a botanical garden and arboretum. This land has an exceptional variety of soil, elevation and exposure, including a border of over one half mile on the Huron River, and the tract is easily accessible from the campus. The opportunities for the study of landscape gardening by our students in engineering, architecture, forestry, and general culture, as well as those in botany and landscape gardening proper, are considerably extended by this gift.—The Woman's League of the university has purchased a seven-acre tract of land, very convenient of access, which will be developed as an

athletic field for the women of the university.—Another welcome gift is in the form of about fifteen hundred acres of land, the purchase price of which, beyond possibly ten per cent. of the value, was donated to the university, lying along the shores of Douglas Lake in Cheboygan County. This land will serve as the site for our summer engineering camp, and its topography, including forest and open, land and water, various elevations, etc., is particularly well adapted to the purpose, and we also look forward to its use as a biological station of importance. In honor of the donor it has been named The Bogardus Engineering Camp.—Buildings completed or practically so during the year include the memorial hall, the gift of alumni and other friends, and a new building for the dental college. The latter, erected at a cost of $125,000, is probably responsible in a large part for the increase in our enrollment in the dental college. Contracts have been awarded for a chemical laboratory to cost $245,000 and an addition to our engineering building to cost $75,000.

The *University of Minnesota* shows a slight decrease in pharmacy, but has made good gains in all other departments, especially in the schools of agriculture (102), law (99) and medicine (69). The increase in the law school is due to the fact that this is the last year in which students may enter that college upon presentation of a high-school diploma. Beginning with September, 1909, all students entering the college of law will be required to have one year of regular academic work in the college of science, literature and the arts. The large growth in medicine is due to the fact that the medical department of Hamline University has recently been absorbed by the University of Minnesota, which now conducts the only medical school in the state. The college of engineering entered this fall upon the five-year course leading to the degree of B.S. at the end of the fourth, and the professional degree at the completion of the fifth year. The school of mines shows no falling off in enrollment, although the entrance requirements in mathematics were raised this fall. The agricultural department has developed rapidly as a result of the impetus given to that line of work throughout the state, larger provision being made for agricultural training than ever before. The academic department shows a net gain of 42 students, namely, a gain of 48 men and a loss of 6 women, the number of women, however, being still far in excess of that of the men. Compared with last fall, there has been an increase in the total of 398 students, and a practically similar gain if the summer session be included.

Mr. Irvin Switzler, registrar of the *University of Missouri*, reports as follows:

The total registration of the present session shows a relative as well as an absolute increase when compared with preceding sessions. The rate of increase during the two preceding sessions was a trifle less than ten per cent. The registration of the present session exceeds that of the corresponding date of 1907 by 284 students, an increase of almost exactly twelve and a half per cent. This increase is found chiefly in the college of arts and science, the teachers college, the school of agriculture, the department of law and in the department of journalism, which was inaugurated this session with an enrollment of 60, as indicated in the table under the head of "other courses."—The steady increase which has been noticed in the college of arts and science in preceding sessions has continued, being due to the growing appreciation on the part of students of the advantages of college preparation for professional work. The rapid growth of the high schools in Missouri has led to an increased demand for trained teachers. This has contributed to the increase in the teachers college, which has also attracted many superintendents and principals who desire advanced courses.—While the engineering courses show a slight increase, the freshman classes in this department show a decrease, probably due to the effect of the financial depression upon the demand for graduates in engineering. Some who would otherwise have entered the engineering department have taken up agriculture. The registration in this school has also been favorably influenced by the spread of information regarding the importance of scientific training in this field.—The department of law has recovered the ground lost during the preceding session, on account of

increased entrance requirements, and has in addition made a substantial increase. The department of medicine has suffered from the uncertainty regarding the future due to plans for removing the last two years to St. Louis or Kansas City. The matter is still pending, but will be determined during the present session. While the graduate department shows exactly the same registration as during the preceding session, the number who are candidates for degrees has increased.

On account of ill health Dr. R. H. Jesse resigned as president of the university on July 1, after an administration of seventeen years, and was succeeded by Dr. A. Ross Hill, formerly dean of the college of arts and science of Cornell University. Before accepting the latter position Dr. Hill was dean of the teachers college of this university, and he is familiar with the educational problems of this state and section. His formal inauguration as president occurred on December 10 and 11, 1908.

This university conducts extension courses at St. Louis, Kansas City, St. Joseph, Joplin, Nevada and Sedalia, but as the registration does not begin until after November, it has not been included in the table. The registration in extension courses during the session of 1907–8 was 134.

The total gain in the fall enrollment is 265, and the summer session shows an increase of 56 students. As the first item of double registration (416) is 102 in excess of that of last year, no accurate comparisons can be made by faculties with 1907.

The *University of Nebraska* has made a gain of 342 in the grand total and of 270 in the fall total, this year's summer session having attracted 104 students more than that of 1907. Agriculture shows the greatest increase—one of 140 students, and music has gained 50. A teachers college was established this year and has drawn students from the academic department, thus at least partially explaining the falling off of 149 women in the latter department. The registration of men in the college and the law school enrollment have remained stationary, while the scientific school has lost 40, and the medical school 20 students. The graduate school and the school of art have also suffered a slight loss.

The school of commerce has contributed most heavily (200) to the gain in the fall attendance at *New York University* of 224 over last year. Owing primarily to increased standards for entrance to the professional schools of law and medicine, the enrollment in these schools has suffered a loss—of 36 in law and of 67 in medicine. The teachers college has gained 49, the engineering school 31 students, and the academic department 19 men and 31 women, while the graduate school has remained stationary, and veterinary medicine has lost 11 students. Of the 298 men registered in the college of arts, 143 are at University Heights and 155 at Washington Square, while all of the 167 women in this division are at Washington Square. The summer session was larger by 86 students than that of the preceding year, the grand total increase being one of 303 students.

Northwestern University's grand total is about 400 in excess of last year's, representing a gain of 15 per cent. Of the 270 students mentioned under other courses, 234 are enrolled in the school of oratory and 36 are attending the special pre-medical course. Mr. William H. Long, secretary to the president, writes as follows:

Northwestern University shows an increase of almost twenty per cent. in the fall enrollment. The gain is especially noticeable in the college of liberal arts, which enrolls 480 men against 389 the year previous. On the other hand, there has been a decrease in both the percentage and the actual number of women. The gain is noteworthy coming in a year in which the tuition fee is raised twenty-five per cent. A part of the increase in the number of men is due to the fact that the first class of engineering students are included in the college of liberal arts. The college of engineering will be formally inaugurated in the fall of 1909. Mr. John F. Hayford, of the United States Coast and Geodetic Survey, has been elected director. A course has been outlined that will require five years. At the end of the fourth year

the student will receive the degree of bachelor of science, and at the end of the fifth year an engineering degree. This year students are accepted in the beginning work only. In the medical school the admission requirements have been advanced one year. The effect upon attendance has been slight, as the figures are practically the same as those of last year. The only school that shows a decided decrease is the dental school, which feels, for the first time, the full effect of the recent large increase in entrance requirements. The new school of commerce meets with remarkable success. More than 200 students are in the first year of the course. The entire course will extend through three years.

On the campus at Evanston the Swift hall of engineering is nearing completion. Ground has been broken for a new gymnasium and the foundation is nearly completed. This building is the gift of Mr. James A. Patten. It will be of white stone and brick. It will contain a club room and social rooms for men, offices for various student enterprises, a large swimming pool, locker rooms, baths, a large gymnasium room, 87 by 135, of the usual type. A rather unique feature is the "indoor field," which will provide for field sports. This field is a room, 120 feet by 215, clear from supports, and having a dirt floor surrounded by a ten-lap-mile track of dirt. This room will accommodate a full-size baseball diamond and two of the three field positions.—Plans for dormitories are under way, but their erection has been held in abeyance.

Ohio State University reports an increase in the grand total registration of 356, and gains this fall in every department with the exception of law. The college has gained 54 men and 27 women; the scientific schools 72, agriculture 45, veterinary medicine 29, the graduate school and domestic science (other courses) 25 each, pharmacy 19, forestry 18 and pedagogy 12 students, while law has lost 11. Of the 925 students in the scientific schools, 43 are enrolled in the so-called short course, two years in length, and similarly there are 68 short-course students in agriculture out of 216 and 4 in domestic science out of 119. The summer session experienced an increase of 78 students.

Mr. Edward Robins, assistant secretary of the *University of Pennsylvania*, has furnished the following descriptive material to accompany the figures of this institution:

The final figures of registration for the current academic year at the University of Pennsylvania show a substantial and gratifying increase over corresponding figures for the preceding year. The net registration for the entire university is 4,555, an increase of 277, or 6½ per cent. over last year. Every department but one has practically equaled or exceeded its registration for the previous year, and in that department additional entrance requirements, which operate for the first time this year, have materially affected the total. The college, with an increase of 127 students, now numbers 1,853. The law department has increased from 303 to 326; the department of veterinary medicine from 131 to 150; the graduate school from 336 to 339; the evening school to 272 from 223. The dental department's total, 383, is 7 less than last year's figure. The attendance in the college courses for teachers is 352, and may be increased by late registrations during the next few weeks. The summer session of 1908, with an enrollment of 472, exceeded that of 1907 by 110 students. The medical department begins the year with 563 students, or 42 less than last year, due largely, as stated above, to a raising of the standard of entrance requirements. Heretofore, the requirements for admission to this department have been equivalent to those prescribed for admission to the freshman class of the college, but for the academic year 1908–9 a knowledge of physics, chemistry and general biology or general zoology and two foreign languages is demanded. Entrance requirements for the next two years will be further raised so that in 1910–11 candidates must have completed work equivalent to that prescribed for the freshman and sophomore classes in colleges recognized by the university.

The enrollment of students in the college is distributed by courses as follows, every course sharing in the increased registration of the department: architecture, 168; arts, 323; biology, 49; chemistry, 78; chemical engineering, 58; Wharton school of finance and commerce, 463; civil engineering, 292; mechanical engineering, 387; music, 35; total, 1,853.

Interest in registration figures naturally centers in the freshman class, which this year for the whole university numbers 1,258, an increase of 126, or 11 per cent. The college shows an excep-

tional gain of 25 per cent., the enrollment now being 611. The law and veterinary medicine classes, 146 and 63, respectively, have each increased ten. The medical and dental departments each show a slight falling off, the registration being 160 and 121, respectively, as against 188 and 139 for last year. The evening school enrolls 157 regular students, an increase of 29.

The growth of the university as represented by the foregoing figures is more readily appreciated when a comparison is made with the registration of five years ago. Since 1903 the university has increased its student population 69 per cent. The college, the department of veterinary medicine and courses for teachers have practically doubled their enrollment. The graduate school has increased 68 per cent. and the professional schools have increased materially. The evening school of accounts and finance and the summer school have sprung into being during this period. The corps of professors, instructors and assistants has been augmented nearly fifty per cent., the total teaching force now approximating five hundred. The physical equipment of the university has had valuable additions in the several years past in the new laboratories and buildings of the departments of medicine, veterinary medicine, engineering and physical education, while the construction of new dormitories enables the university to house seven hundred of its students in these comfortable apartments.

Princeton University's total is practically the same as that of last year, 1,314 in 1908 as against 1,311 in 1907. The academic department lost 24 students and the graduate school 21, whereas the scientific school shows a gain of 50 students.

At *Stanford University* there has been a net loss in the fall registration of 51 students, the gain of 33 graduate students, 48 law students and 19 women in the academic department not quite offsetting the loss of 151 men in the latter department (including the scientific school). Mr. O. L. Elliott, registrar of the university, writes as follows:

A tuition fee of twenty-five dollars per semester has been instituted in the department of law, applicable to all students in law not registered in the department on March 1, 1907. (There are no tuition fees in other departments of the university.)

The Cooper medical college of San Francisco has been transferred to the university as a free gift, and a department of medicine has been instituted in the university. Instruction will begin in September, 1909. There will be a four-years' course in medicine, preceded by not less than three years of collegiate work. One and a half years of the medical course will be given at Palo Alto, and the remaining two and a half years in San Francisco.

The falling off in the number of students may be attributed partly to the effects of our disciplinary upheaval last year, and partly to the unusual number of failures in scholarship during the second semester of last year.

It should be remembered that the number of students at Stanford University is strictly limited.

Syracuse University reports a gain in the fall total of 41 and in the grand total of 42, the summer session showing a decrease of 16, but fewer students having returned for work this fall than was the case last year. A loss of 53 in pedagogy is offset by a gain of the same number in music; the graduate school has lost 23, while the college has gained 29 and architecture 11. Law, medicine, and the scientific schools have remained to all intents and purposes stationary. The entrance requirements in medicine have been increased, so that next fall one year, and in the fall of 1910 two years, of college work will be demanded for admission, the college work to include a competent course in physics, biology, chemistry, Latin and one modern language.

The Lyman Hall of natural history is now fully occupied by the departments of biology, geology and mineralogy, and botany, while the work in chemistry has been transferred to Bowne Hall. The gymnasium will be ready for occupancy at the opening of the second half-year.

The attendance at the *University of Virginia* is exactly the same as last fall, al-

though several changes have taken place in the distribution of the student body by faculties. The decrease in enrollment in the college (24), the scientific schools (11), and medicine (14), may be attributed to increased requirements for admission that became operative this fall. The gain in the law school is due primarily to the fact that the course becomes one of three years, instead of two, beginning with 1909–10. A number of students transferred from the college to law this fall, in order to complete their law course before the new requirement goes into effect. The graduate school has remained stationary. A new course has been established in the engineering department leading to the degree of chemical engineer. An additional wing has been provided for the university's hospital group of buildings; also a commons hall, which furnishes table board to students at cost.

Western Reserve University on October 1 incorporated a pharmaceutical school with 75 students, and has gained 27 students in addition over last year. The academic department shows an increase of 33, all men, while law has gained 9 and the library school (other courses) 7 students. On the other hand, dentistry shows a loss of 12, the graduate school of 5, and medicine of 4 students. The 80 students mentioned under extension teaching are in attendance on standard university courses given in the evening.

Mr. D. C. Mathews, executive secretary, writes as follows:

The opportunities offered by the medical school will be largely increased by the opening of the new H. K. Cushing laboratory of experimental medicine. The department of experimental medicine was made possible by the gift of $100,000 each by Mr. H. M. Hanna and Colonel Oliver H. Payne. Professor George N. Stewart, formerly of the University of Chicago and recently returned from a year's study in Europe, is head of the department. The building was dedicated on November 20, the principal address being delivered by Dr. William H. Welch, of Johns Hopkins University.

Work is progressing upon the chemical laboratory on the Adelbert College campus. The building is named for Professor Edward Williams Morley, for thirty-seven years professor of chemistry in Western Reserve.

The Cleveland School of Pharmacy was recently incorporated into the university. The school is now in its twenty-seventh year. The course of study includes thorough courses in general, inorganic and organic chemistry, physics, pharmacy, materia medica, microscopy and physiology. It is proposed to give to the course of study certain larger relationships than its merely technical requirements would demand.

The *University of Wisconsin* reports an increase of 360 students in the fall enrollment, and of 475 in the grand total, the summer session having attracted no less than 376 students more than attended the session of 1907. All of the faculties have contributed to the gain in the fall registration: The academic department 85 men and 42 women, agriculture 72, the scientific schools 26, music 14, law 8, medicine 6, and pharmacy 4 students. The graduate school shows an actual increase of 14 students over last year, although there is an apparent loss of 137. This is due to the fact that the figures for last year included the graduate students who attended the 1907 summer session and did not return for work in the fall; of these there were 151. This year there were 227 graduate students in attendance at the summer session only, so that the total registration of graduate students is 353 for 1907 and 443 for 1908. The first item of double registration (151) is made up of 114 students enrolled in letters and arts, as well as in law, music and medicine, plus 37 students given separately under pharmacy.

There have recently been established a course in chemistry, a course in mining engineering, and a middle course in agri-

culture. The two former are four-year courses, leading to a baccalaureate degree. The last is a two-year course, the entrance requirements for which are the same as those of the regular long course, certificates being awarded at the close, instead of degrees. There has also been organized, within the college of letters and science, a new course for the training of teachers. Within the past year a new central heating plant has been built, as well as an addition to the administration building. A woman's building and a new animal husbandry building are in process of construction.

The increase in *Yale University's* grand total is one of 31, while that for the fall only amounts to 149, the discrepancy being due to the withdrawal of the summer school of this institution; the 48 students mentioned under summer session attended the summer school of forestry. Gains in the fall attendance have been registered by every department with the exception of the academic, which shows a loss of 41 students, whereas the Sheffield scientific school has gained six. To the enrollment of the latter should be added 154 graduate students who are members of the graduate school or the school of forestry. The law school reports a gain of 92, the graduate school one of 51, divinity 26, art 10, forestry 9, music 8, and medicine 5.

RUDOLF TOMBO, JR.
COLUMBIA UNIVERSITY

THE NATIONAL GEOGRAPHIC SOCIETY

THE arrangements for lectures for the current season are as follows:

December 11—"The Redemption of Ireland," by Mr. William E. Curtis. No longer does the Irishman in Ireland live on potatoes and peat. Illustrated.

December 18—"Present Conditions in Turkey," by Dr. Howard S. Bliss, president of the Syrian Protestant College, Beirut.

January 4—"The Sierra Nevada," by Dr. Grove Karl Gilbert.

January 8—"A Digger's Work in Palestine," by Dr. Frederick J. Bliss, author of "A Mound of Many Cities," "Excavations in Palestine," etc.

January 15—"The Non-Christian Tribes of the Philippine Islands," by Dr. Frederick Starr, of the University of Chicago.

January 22—"The Panama Canal and the Spanish Main," by Mrs. Harriet Chalmers Adams.

January 29—"Abraham Lincoln—Boy and Man," by Mr. W. W. Ellsworth, of the Century Company.

February 5—Major General A. W. Greely, U. S. Army, will address the society.

February 12—"The Bird Islands of Our Atlantic Coast," by Mr. Frank M. Chapman, of the American Museum of Natural History. Illustrated with lantern slides and moving pictures of the pelicans and fish hawks.

February 19—"Java—The Garden of the East," by Mr. Henry G. Bryant.

February 26—"Aerial Locomotion," by Mr. Wilbur Wright or Mr. Orville Wright.

March 12—"The Hunting Fields of Central Africa," by Mr. Gardiner F. Williams, for twenty years general manager of the De Beers diamond mines at Kimberley.

March 19—"Ruwenzori, the Snow-crowned Mountain of the Equator," by Professor Edwin A. Fay, of Tufts College, president of the American Alpine Club.

March 25—"Brittany—The Land of the Sardine," by Dr. Hugh M. Smith, deputy commissioner of the U. S. Bureau of Fisheries.

April 2—"Homes for Millions—Reclaiming the Desert," by Mr. C. J. Blanchard, of the U. S. Reclamation Service.

A BIBLIOGRAPHY ON SCIENCE TEACHING

AT a meeting of the executive committee of the American Federation of Teachers of the Mathematical and Natural Sciences held April 28, 1908, it was voted to appoint a committee on bibliography of which Professor Richard E. Dodge, of Teachers College, New York, is chairman.

This committee was requested to prepare, at an early date, a selected and annotated bibliography on science teaching for publication by the federation. The field to be covered includes teaching in elementary, secondary and normal schools and colleges. The list is to

"include books, articles in periodicals, scientific journals or association reports, including foreign contributions, if any." The object is to prepare a bibliography of contributions to science teaching in the last decade "that will be a working basis for any teacher of science and especially for any in an institution with limited library facilities." Since reviews of recent publications on science teaching are valuable in making up programs of study or for meetings, this bibliography should be an aid in this way, and should thus encourage the study of the literature of the subject.

For convenience and effectiveness in covering the whole field of science teaching, specialists were appointed to undertake the work in each of six subdivisions. The cooperators and the work for which each will be responsible are given below:

Mathematics—Professor J. W. A. Young, University of Chicago.

Biology—Professor O. W. Caldwell, University of Chicago.

Physics—Professor John F. Woodhull, Teachers College, Columbia University, and ex-president of New York Physics Club.

Nature-Study—Professor M. A. Bigelow, Teachers College, and secretary of the American Nature-Study Society.

Chemistry—Special Committee of the New England Association of Chemistry Teachers.

Geography and Geology—R. H. Whitbeck, State Model School, Trenton, N. J.

It is anticipated that the special reports will be in the hands of the chaiman before January 1, 1909, and that the bibliography can be printed and distributed early in the next calendar year.

SCIENTIFIC NOTES AND NEWS

The convocation week meetings of the American Association for the Advancement of Science, and the twenty-five national scientific societies meeting this year in affiliation with it, have begun at the Johns Hopkins University, Baltimore, as we go to press with the present issue of Science. We publish above the address of the retiring president of the association, Professor Edw. L. Nichols, of Cornell University, and we hope to publish next week a general account of the meeting, to be followed in subsequent issues by the addresses and proceedings of the association and the affiliated societies.

The recently created Royal Society of South Africa has elected Sir David Gill, K.C.B., F.R.S., its first honorary fellow.

Dr. William Evans Hoyle, director of the Manchester Museum, has been appointed director of the Welsh National Museum.

Dr. F. Walker Mott, F.R.S., has been elected Fullerian professor of physiology in the Royal Institution.

Certain friends of the chancellor of Cambridge University desire the establishment of some award to be associated with Lord Rayleigh's name, in order to commemorate the unanimous election of a scientific investigator to the office of chancellor of the university. With this object they have deposited a sum of money, the interest of which may be used for the purpose of awarding from time to time a prize to be called the Rayleigh prize.

Professor Sir James Dewar has been elected an honorary member of the German Chemical Society.

The president of the Cambridge Philosophical Society, Professor Adam Sedgwick, has been appointed to represent the society at the Darwin Centenary celebrations in June, 1909.

The Broca prize for 1908 has been awarded by the Anthropological Society of Paris, to Dr. Paul Rivet.

The Godard prize of 1,000 francs has been awarded by the Paris Academy of Medicine, to Dr. F. W. Pavy, F.R.S., consulting physician to Guy's Hospital, London, for his works on carbohydrates and diabetes.

Mr. George H. Locke, for the past two years professor of the history and principles of education and dean of the School for Teachers of Macdonald College, McGill University, Quebec, Canada, has resigned to become chief librarian of the Municipal Libraries of the city of Toronto.

Jerome J. Green, professor of physics and electrical engineering at the University of

Notre Dame, has taken up his work after a year's leave of absence, which was spent traveling in Europe, visiting the principal educational institutions. He attended lectures at the University of Paris and at the Technische Hochschule in Berlin.

PROFESSOR HUGO MÜNSTERBERG has returned to Harvard University from a trip to Chicago, Toronto and Ithaca. He spoke in Chicago before the Chicago Club on "Psychotherapy," before the Germanic Society on "Books and Readers in Germany and America," and before the Commercial Club on "Psychology in Commerce and Industry." In Toronto he addressed the Canadian Club on "Right and Wrong in the Prohibition Movement." At Cornell University he spoke on "New Developments in the Psychological Laboratory" and "Psychology and Law."

ON January 13, at 4 o'clock, Professor Cassius J. Keyser, of Columbia University, will deliver a lecture before the departments of mathematics and philosophy of the Brooklyn Institute of Arts and Sciences on "The Message of Modern Mathematics to Natural Theology."

THE Chicago Chapter of the Sigma Xi Society held its fall meeting on December 9. Dr. Chas. H. Judd, professor of psychology of Yale University and director-elect of the School of Education of Chicago University, gave an address on "Visual Perception and Eye Movements." Fourteen members joined the society at this meeting.

DR. J. B. LEATHES, of the Lister Institute, London, will deliver six lectures on the subject "The Metabolism of the Non-nitrogenous Substances in the Animal Body" in the Carnegie Laboratory of the University and Bellevue Hospital Medical College, New York City, beginning on Monday, January 4, 1909, and continuing daily throughout the week, at four o'clock in the afternoon. Those interested are cordially invited to attend the course.

THE Friday evening meetings of the Royal Institution, London, will begin on January 22, when Dr. Alfred Russel Wallace, O.M., will deliver a discourse on "The World of Life: as visualized and interpreted by Darwinism."

THE Wilde lecture of the Manchester Literary and Philosophical Society will be delivered on March 9, by Dr. H. Brereton Baker, F.R.S., reader in chemistry in the University of Oxford, the subject being "The Influence of Moisture on the Combination of Gases."

As this year is the jubilee of Speke's discovery of the Victoria Nyanza, the long-sought-for source of the Nile, the Royal Geographical Society commemorated the event by a special meeting on December 14, when Sir William Garstin gave an address on "Fifty Years of Nile Exploration and some of its Results." There was an exhibition of portraits, Speke's original map of his discoveries, and other maps, instruments, photographs, etc.

PROFESSOR THOMAS GRAY, professor of dynamics and engineering at the Rose Polytechnic Institute, eminent for his researches in these subjects, died on December 19 at the age of fifty-eight years.

THOMAS M. WILSON, B.Sc. (Toronto), M.D. (Rush), about to receive the degree of doctor of philosophy at the University of Chicago where he had been assistant in physiology, instructor in pathology in the Chicago Veterinary College, died on November 19 from glanders contracted in the laboratories of the McCormick Memorial Institute in an attempt to produce a serum to counteract the effects of the bacillus of the disease.

PROFESSOR EDUARD G. VON RINDFLEISCH, the eminent pathologist, died at Würzburg on December 5, at the age of seventy-two years.

THE death is also announced of Dr. Giuseppe Ciscato, professor of theoretical geodesy in the University of Padua, at the age of fifty-one years.

ACTING under instructions from President Roosevelt, the Secretary of the Interior has withdrawn from entry, selection and location all public lands in Wyoming, Idaho and Utah believed to contain phosphate rock, pending action by congress.

DR. ARTHUR J. EVANS, F.R.S., has given to the Ashmolean Museum of Oxford University

the collection of Anglo-Saxon jewelry and other relics bequeathed to him by his father, the late Sir John Evans. With it is also a comparative series illustrating the early Teutonic art of the continent, including specimens of Scandinavian, Frankish, Lombard and Gothic work.

It is announced that the collection of implements of the bronze age, formed by Canon William Greenwell, of Durham, will be presented to the British Museum. This collection of implements of the bronze age is regarded as the most extensive of its kind in private hands, and is said to compare well in many respects with that already in the British Museum. It includes specimens from nearly all parts of Great Britain and other countries of Europe, and also from Asia.

The Royal Society has given to Cambridge University the stellar spectroscopic equipment which has been in the care of Sir William Huggins since 1871. It consists of the following instruments: A refracting telescope with an object glass 15 in. in diameter and 15 ft. in focal length, to which is attached a spectroscope arranged for both visual and photographic work; and a Cassegrain reflecting telescope with a mirror made of speculum metal 18 in. in diameter and about 7 ft. in focal length, to which a spectroscope is attached with optical parts made of Iceland spar and quartz for photographing the ultra-violet spectrum of stars. These two telescopes are mounted equatorially on a single polar axis, in such a way that they can be moved independently in declination. They are at present installed in a dome about 20 ft. in diameter in Sir William Huggins's garden at Tulse-hill. The telescopes and the equatorial mounting were made by Sir Howard Grubb in Dublin, and the spectroscopes by Messrs. Troughton and Simms. The instruments are described as being in excellent working order, and would only require such insignificant changes as are usually needed in passing from one series of observations to another in the ordinary work of an observatory, but a suitable dome will have to be provided for the proper installation of the telescopes.

A plan for a new exhibition room on the second floor of Peabody Museum of Yale University has been given up and the restored mastodon is being set up in an exhibition room on the third story. The museum has become so overcrowded that future plans for exhibition have to be restricted. An increasing amount of the space in the building is demanded for scientific laboratories and classroom work.

The Rev. Joseph Beech, missionary in West China, has presented to the museum of Wesleyan University a collection of ethnological specimens from China and Tibet, which includes about 800 coins and about 300 other specimens. Among these are idols and other objects used in worship, domestic utensils, carvings in jade, ivory and other materials, pictures and books. From the widow of the Rev. Merrill Hitchcock the museum has received Mr. Hitchcock's herbarium.

Mr. James Gordon Bennett has offered the Aero Club of France a new international prize. A cup of the value of £500 is to be competed for next year in France under the auspices of the International Aeronautic Federation and the French Society for the Encouragement of Aerial Locomotion. Besides this cup Mr. Gordon Bennett offers three sums of £1,000 each to be given to the winner of each of the first three annual competitions.

At the monthly meeting of the British Astronomical Association, on November 25, by the permission of the astronomer-royal, the long series of photographs of comet 1908c Morehouse taken with the 30 in. reflector of the Royal Observatory were shown on the screen and described by Mr. Melotte.

As already announced, the Australasian Association for the Advancement of Science will meet in Brisbane on January 11. According to *Nature*, the association will come of age next year, and the meeting will inaugurate the jubilee year of Queensland, the history of which as a separate state dates from 1859. The new president of the association is Professor W. H. Bragg, of Adelaide, while the sectional presidents are Professor Pollock, of Sydney (astronomy, mathematics, and

physics); Professor Easterfield, of Wellington, N. Z. (chemistry); Professor Skeats, of Melbourne (geology and mineralogy); Mr. Charles Hedley, of Sydney (biology); Mr. A. H. S. Lucas, of Sydney (geography); Mr. A. G. Hamilton, of Wellington, N. Z. (ethnology and anthropology); Mr. G. H. Knibbs, of Melbourne (social and statistical science); Mr. H. W. Potts, of the Hawkesbury College (agriculture); Professor R. W. Chapman, of Adelaide (engineering and architecture); Dr. J. Mason, of Wellington, N. Z. (sanitary science and hygiene); Mr. Peter Board, of Sydney (mental science and education). The acting permanent secretary, Mr. J. H. Maiden, can be addressed at the office of the association, Royal Society's House, Sydney, and will be glad to give further particulars and to enroll members for New South Wales.

Nature states that a movement, supported by the Linnean Society of New South Wales, is on foot to approach the Australian government with the object of having Barrow Island, sixty miles off the northwest coast, set apart as a fauna reserve. The island, which is remarkable for its kangaroo, bandicoot, rat, and wren, none of which occurs on the mainland, is likely to be leased for sheep-farming, to the detriment of the fauna. The policy of the Crown's retention of islands as sanctuaries for wild life is being amply justified by the experiences of New Zealand and the United States, and the Barrow Island fauna is worth effort to save.

THE MORLEY CHEMICAL LABORATORY OF WESTERN RESERVE UNIVERSITY

THE open weather of the fall and winter has made it possible to push more rapidly the construction of the new Morley Chemical Laboratory of Western Reserve University. This building, which will house the departments of chemistry and geology of both undergraduate departments of the university, is situated upon the Adelbert College campus. It will provide accommodations sufficient for three hundred students in chemistry and one hundred and fifty students in geology.

The building is collegiate gothic in style, is built of brick and concrete, with Indiana limestone trimmings, and is of fire-proof construction. It is three stories in height. The first floor will contain two large laboratory rooms, recitation rooms, offices, small research laboratory, dark rooms, a workshop and storeroom. On the second floor there will be two large laboratories, the main lecture room, with preparation room adjoining, a storage room, a small laboratory, balance room and offices. The third floor will be largely devoted to the department of geology, which department will occupy a large lecture room, a laboratory for students, a private laboratory, offices and a storeroom. This floor will provide, also, additional recitation rooms, library and reading room and a small laboratory for electrochemistry for the department of chemistry. The laboratory building will cost one hundred and twenty thousand dollars and will be ready for occupancy in September, 1909.

The library of the department of chemistry will include the Morley collection of books on chemistry. These books were assembled by Professor Morley during his years of active association with Western Reserve and were given by him to the university. These books are now being reclassified and recatalogued.

UNIVERSITY AND EDUCATIONAL NEWS

THE regents of the University of Wisconsin, in accordance with the recommendation of the State Timber Land Owners' Association and the Wisconsin Conservation Commission, proposed to the United States government to provide a suitable building on the university campus for the use of the U. S. Forestry Service as a laboratory for the investigation of problems connected with the utilization of forest products. The proposed building will cost $30,000, and will be furnished with heat, light, and power by the university. The U. S. Forest Service desires to concentrate at some engineering college in the west all of its present laboratories. The purpose is to carry on an elaborate series of investigations upon all kinds of timber, with reference to adapting each to its best use, and to utilizing timber, stumps and refuse now wasted. The utilization of the by-products of the logging

operations, the making of wood pulp from various kinds of timber, the distillation of turpentine and other products of wood waste, and similar problems are to be included in the forestry work. The United States government will equip the proposed building at a cost of $14,000, and will provide the entire staff of investigators, whose salaries will aggregate $28,000 a year. The laboratory is to be available for advanced university students and instructors in forestry and chemical engineering. The scientific men provided by the forestry service for the laboratory are to give lectures in the university.

The University of Chicago gives the first two years of the medical curriculum of Rush Medical College, which is affiliated with the university. In order to encourage the spirit and method of investigation among students preparing to study medicine, the university offers three scholarships for the session of 1909–10, to be awarded to applicants presenting the best theses embodying the results of independent investigation in any of the sciences fundamental to medicine—physics, chemistry, or any of the biological sciences. The first prize will be a scholarship for three quarters ($180), the second prize a scholarship for two quarters ($120), and the third prize a scholarship for one quarter ($60). This competition is open to members of the graduating class or graduate students of this college. Theses must be sent to the dean of medical courses, The University of Chicago, on or before April 1, 1909.

Arrangements have been made at Lehigh University to keep the conference department open during the Christmas recess. This department, composed of instructors of the university under the direction of one of the professors, is designed to assist students who find difficulty with their current work. It is an innovation in college policy, which is said to have proved a great help since its establishment last September.

By a resolution of the senate of the University of London, it has been decided to ask the government to appoint a royal commission with a view to the introduction of a bill to secure incorporation of the Imperial College of Science and Technology with the University.

We are informed that the note given prominence by the New York papers and reprinted in Science to the effect that Governor Johnson had asked President Roosevelt to accept the presidency of the University of Minnesota is incorrect.

Dr. Adam Sedgwick, professor of zoology at Cambridge, and fellow at Trinity College, has accepted a professorship of zoology at the Imperial College of Science and Technology, London.

At the University of Glasgow, Dr. Cecil H. Desch, of University College, London, has been appointed to the Graham Young lectureship in metallurgical chemistry to succeed Dr. C. E. Fawsitt, who resigned to accept the newly-established chair of chemistry in the University of Sidney, N. S. W.

DISCUSSION AND CORRESPONDENCE

THE "PINCH-EFFECT" IN UNIDIRECTIONAL ELECTRIC SPARKS

Professor Nipher has recently described[1] some interesting experiments on momentum effects in electric discharge, and writes as follows concerning the unidirectional sparks obtained by the insertion into the circuit of strips of cloth moistened with a saline solution:

> . . . the sparks are large and brilliant at the negative end in both positive and negative lines, and thin out towards the positive end. The negative terminals are large spheres of about 10 cm. diameter. The positive terminals are small knobs, of about 1 cm. diameter. *While on the large sphere the electrons repel each other. But when they start into motion across the spark-gap, they attract each other electromagnetically.* This appears to be the reason why the spark thins out as the electrons proceed in their motion across the spark-gap. [The italics are mine.]

According to theory, two like charges repelling each other when at rest, begin to develop an electromagnetic attraction for each other as soon as they are put in motion in the same direction. But this attraction does not be-

[1] Science, December 4, 1908, p. 807.

come equal to the electrostatic repulsion until the charges move with the velocity of light. This used to seem very puzzling to me, for I reasoned as follows: Imagine a positively charged hopper filled with steel balls, which continually dropped into two parallel inclined glass troughs. As the motion of the charged balls is constantly accelerated, the electromagnetic attraction which they exert on the charged balls in the other trough grows larger and larger until the velocity is that of light, when the streams of balls in the two troughs are exerting zero force on each other (for their electrostatic repulsion is then exactly balanced by their electromagnetic attraction), and yet they are said to be behaving like electric currents. Why, then, do parallel currents actually attract each other? No one supposes that a current in a wire travels *faster* than light. Some years ago in Cambridge I asked Professor (now Sir) J. J. Thomson about it, and he replied that my analogy was all right, except that according to the electron theory the glass troughs should have a metal covering outside, which is *positively* charged, the hopper should be *negatively* charged, and the positive charge on a unit's length of a trough should equal the sum of the negative charges on the balls contained in that length. Then the analogy, while crude, would be complete: the steel balls would represent electrons, and the current in the ordinary sense would flow *up* the trough instead of down. The charge on the metal covering of the trough would represent the charges on the positive atoms in a conductor. Under these circumstances it is easy to see that attraction between the troughs would ensue as soon as the balls began to move. Professor Nipher's explanation, therefore, would seem to be valid only on the supposition that the positive ions in the line of the disruptive discharge (which are dashing towards the negative terminal) would take the place of the metal-covered trough in my analogy, thus rendering the electromagnetic attraction of the moving electrons effective in drawing them together in a column which continually thins out towards the positive terminal. If this be true, the effect ought to be rendered more intense because of this consideration: the analogy would then be that of the trough itself (carrying a positive charge) *moving in the opposite direction to the motion of the steel balls*, thus making the relative velocity of the balls greater and the attraction more intense.

But there is another way of looking at it which may be more natural. The negative terminal is a large sphere 10 cm. in diameter, while the positive terminal is but 1 cm. in diameter. The lines of force are therefore strongly convergent from the negative to the positive sphere, somewhat like the ropes from the gas bag of a balloon to the much smaller basket beneath, and electrons sliding down these lines (along their negative direction, of course) would naturally arrange themselves in a column larger at the negative end, especially as these lines are themselves falling towards the center line of the discharge. In this case would not the phenomenon simply show the pinch effect in gaseous discharge?

ANDREW H. PATTERSON

UNIVERSITY OF NORTH CAROLINA,
December 7, 1908

MR. MANSON'S THEORY OF GEOLOGICAL CLIMATES

MR. MANSON's theory of geological climates has been commended latterly in the columns of SCIENCE and elsewhere, and it may be desirable to point out why it is unsatisfactory.

The theory as set forth in Mr. Manson's communication to the Tenth International Geological Congress, in Mexico, in 1906,[1] is briefly as follows: During Paleozoic time the climate of the earth was practically uniform from equator to poles, and torrid temperatures were everywhere maintained by heat derived from the earth and warm oceans; the heat was prevented from radiating into space and being lost by a blanket of clouds surrounding the whole earth. Recognizing that the heat brought to the earth's surface by conduction is not enough to keep up a high atmospheric temperature, Mr. Manson thinks that much heat was made available by the erosion of the land and by hot springs, volcanic eruptions, etc. Let us calculate how much heat can be

[1] *Proceedings*, Vol. I., pp. 349–405.

obtained by this means, and in making this calculation we give every possible advantage to the theory. Let us assume with Dr. Becker[2] that at the time of consolidation the surface of the earth was at a temperature of 1300° C., and increased at a uniform rate at least to a depth of 0.02 of the radius or 126 kilometers, and that up to the present time no appreciable change of temperature has taken place beyond that depth. Let us further assume that the surface has been reduced to 0° and that the present temperature gradient is a straight line from the surface to a depth of 126 kilometers. The average loss of temperature within this shell is 1300/2 or 650°, and if we take the specific heat per cu. cm. as 0.5 calories, the total heat which has been lost per sq. cm. of surface is $12,600,000 \times 650 \times 0.5 = 4.1 \times 10^9$ calories. This is a very liberal allowance.

Assuming an ocean 5 kilometers deep covering the whole earth, whose original temperature was 40° C. and which has cooled to 0°, the total heat given out per sq. cm. of surface would be (specific heat per cu. cm. $= 1$), $500,000 \times 40 = 2 \times 10^7$ calories. This is only one half of 1 per cent. of the heat furnished by the land and may therefore be neglected.

The heat at present being received from the sun equals 2 calories per sq. cm. per minute, measured at right angles to the sun's rays.[3] As this falls on the section of the earth it must be divided by 4 to give the average amount on the earth's surface. Let us suppose, further, that three fifths of the remainder is lost by reflection and other causes and does not heat the earth's surface. This leaves 0.2 calorie for the average amount received by 1 sq. cm. of the earth's surface per minute; and in one year the total amount received would be $0.2 \times 60 \times 24 \times 365 = 10^5$ calories, and as the earth has a practically stationary temperature it is losing this much heat per year by radiation into space. At this rate all the heat lost from the earth since consolidation could only keep up the present average temperature for a number of years equal to $4.1 \times 10^9/10^5 = 41,000$ years; but if on account of the cloud-blanket only 10 per cent. as much heat is necessary to maintain the temperature it would last 410,000 years; if only 1 per cent. were needed, it would last 4,100,000 years, a period much shorter than pre-Mesozoic time.

But what would establish and maintain a blanket of clouds around the earth, and especially over great inland regions like the centers of Africa and Asia? The only places where clouds are now prevalent are places in high latitudes where moisture is continually precipitated from the winds which blow pretty steadily from warm seas; but even with our present atmospheric circulation the interior of the great continents are rather dry. With the uniform temperature which Mr. Manson predicates in Paleozoic time there would be no winds, and the sun would soon break up the cloud-covering over the interior of the continents, as there would be no steady supply of moisture. Moreover, an atmosphere heated at the bottom is in unstable equilibrium, and convection currents would be set up which would carry the moist air to high altitudes and result in heavy downpours of rain and a clearing of the atmosphere; for the available heat would be entirely inadequate to supply moisture to form clouds as fast as it would be precipitated as rain. The existence of clouds would have no influence on the convection currents. Mr. Manson mentions these currents, but does not attach any great importance to them.

It is to be noted that geologists who have given attention to the earlier glacial periods do not consider that they were due merely to small glaciers at high altitudes, but that they represented real, even if not very extensive, changes in climate. Moreover, Professor J. W. Gregory firmly maintains that throughout g ological times we have had a zonal distribution of temperature very similar to that of the present day.[4] It is therefore, quite possible that the continued uniform climate which Mr. Manson's theory was developed to explain, did not really exist.

Professor Schaeberle[5] approves Mr. Manson's theory and states that "The inherent

[2] SCIENCE, February 7, 1908.

[3] SCIENCE, April 24, 1908, p. 663.

[4] "Climatic Variations," *Proc. Tenth Intern. Geol. Cong. Mexico*, 1906, Vol. I., pp. 407–26.

[5] SCIENCE, March 6, 1908, p. 392.

heat of the earth still plays an important if not controlling part in all terrestrial phenomena. . . ." This idea is based on an earlier communication[6] whose conclusions are invalidated by his erroneous definition of temperature and by his erroneous assumption that a body placed in a stream of radiant energy has its temperature raised by an amount proportional to the quantity of radiant energy falling upon it in a unit of time.

It can readily be shown that the heat received by conduction from the earth is insignificant in comparison with that received from the sun, as was long ago done by Lord Kelvin. The quantity of heat reaching the earth's surface per minute through each sq. cm. equals the conductivity of the rock multiplied by the temperature gradient multiplied by 60 seconds. If we take the conductivity of rock at 0.005 and the temperature gradient at 0.00032° C. per cm. (which corresponds to 1° C. per 31 m. or 1° F. per 50 feet) we find 9.6×10^{-5} for the quantity of heat conducted to the surface per sq. cm. each minute, and since we can take the quantity received from the sun for the same area in the same time as 0.2 calorie, we see that the earth's surface receives from the sun at least 2,000 times as much heat as from its interior. The latter, therefore, could not have a material effect on the surface temperature or on atmospheric phenomena.

HARRY FIELDING REID
JOHNS HOPKINS UNIVERSITY,
November 28, 1908

[6] SCIENCE, December 20, 1908, p. 877.

ON MISLEADING STATEMENTS

SINCE misleading statements occur in the publications of certain writers concerning my participation in, and experimental contributions to the subject of blood-vessel anastomosis and transplantations, in justice to myself and in the interest of investigators in general, it is incumbent upon me to perform the disagreeable task of making a statement once for all, that the facts may be made readily accessible. The task will be made easier if I am permitted to quote rather freely.

Carrel in a paper appearing in the *Journal of the American Medical Association*, November 14, 1908, LI., p. 1664, says:

> The transplantation of devitalized arteries has been attempted by Levin and Larkin in New York, but in almost every case thrombosis occurred. However, after the transplantation of a segment of aorta fixed in formalin into the aorta of a dog, excellent circulation was observed. Histologic examination ten days after the transplantation showed that the wall was composed of amorphous tissue in which the elastic framework was seen to be very well preserved. In another case of Levin and Larkin, twenty days after the operation, the wall of the vessel was completely amorphous and surrounded by dense connective tissue. *A similar experiment has been performed in St. Louis by Guthrie*, who obtained an excellent functional result, but no histologic examination of the vessel has yet been published.

Levin and Larkin, in *Proceedings of the Society for Experimental Biology and Medicine*, 1907–8, V., p. 110, say:

> On January 23, 1908, we transplanted a segment of aorta from a dog hardened in 4 per cent. formalin into the abdominal aorta of another dog. *Meanwhile Guthrie reported successful implantation of formaldehyde segments into the carotid of the dog.*

The facts regarding the transplantation of formaldehyde-fixed segments are as follows: In the *American Journal of Physiology*, September 2, 1907, XIX., 482–7, in the paper entitled, "Heterotransplantations of Blood Vessels," I stated:

> In this connection it may be mentioned that a segment of aorta from a cat preserved in formaldehyde for about a month, then washed in very dilute ammonia water, partially dehydrated in alcohol and impregnated with vaseline, when similarly transplanted into a dog gave excellent temporary results. On killing the animal with ether and examining the segment, it was found to resemble the artery of the dog in a much greater degree than before being transplanted, being more pliant and having a flesh color, the latter due, no doubt, largely to the presence of blood that got into or between the coats from the outside. The union of the intimas was excellent, and they both had the characteristic glistening appearance. My thanks are due Dr. Bartlett for assistance with this operation. A series of operations are being made with the view of determining the permanent results of similarly prepared and transplanted blood vessels.

My records show that this experiment was performed June 20, 1907. In SCIENCE, N. S.,

March 20, 1908, XXVII., p. 473, is reported the successful transplantation of a formaldehyde-fixed segment of blood vessel into a dog. Since the work had been announced in 1907 in the article referred to above, I did not consider it necessary or even of interest to state the date of the successful operation. Since this appears to have been a mistake on my part, I desire for the benefit of those interested to here record it. My record shows that the operation reported was performed January 22, 1908. On February 12, 1908, the neck was opened and the segment directly examined. On February 29, 1908, the animal was demonstrated before the St. Louis Medical Society.[1] The manuscript of the note in SCIENCE was mailed to the editor February 17, 1908.

Levin and Larkin in *Proceedings of the Society for Experimental Biology and Medicine*, 1907–8, V., 109, also say:

Carrel demonstrated that it is not only possible to unite the two ends of a severed artery by a suture but also to interpose between the cut ends of it a segment of an artery of another animal and perform a double anastomosis. *The success of the operation is due to the fine technique elaborated by Carrel.*[2]

The following quotations from a paper entitled, "Uniterminal and Biterminal Venous Transplantations," by Carrel and Guthrie (from the Hull Physiological Laboratory, University of Chicago), *Surgery, Gynecology and Obstetrics*, March, 1906, II., pp. 266–77, will furnish those interested food for thought:

The transplantation of veins is a new operation, and has been largely developed in this laboratory. Therefore its history is short.

In 1902, however, Carrel had shown that arterio-venous anastomoses were possible, and considered that all the transplantation of veins were feasible. Our present results have entirely confirmed this opinion.

In 1905 we began experimenting in this laboratory[3] with the view, among others, of making a complete study of the transplantation of veins. Several series of experiments were undertaken in order to study the results of the uniterminal and biterminal venous transplantations, and they were thoroughly successful. At this point we wish to thank Dr. Stewart for his interest in this work and his valuable suggestions, which have contributed in no small degree to its success.

In order, therefore, to successfully transplant veins on to the arterial system, it was necessary to have a technique permitting the union of the vessels without hemorrhage or thrombosis. Besides, positive results must be constant, for a method is not satisfactory otherwise. In the first experiments (1902), the technique employed did not always yield good results. Thrombosis often occurred. This was due mainly to the fact that the delicacy of the endothelium of the vessels was not appreciated. This led to a realization of the fact that ordinary surgical methods are inadequate. The methods, for instance, which give splendid results in abdominal surgery are much too rough for use in vascular surgery. The surgery of the blood vessels is a new and special field, and the operative handling must be delicately adjusted and adapted to the nature and the reactions of the tissues.

According to these considerations, our technique was improved by degrees. The threads and the needles were the finest and the strongest obtainable. The threads were sterilized in vaseline, and applied when heavily coated with the same. The vessels were handled very gently, and the endothelium was protected from drying by isotonic sodium chloride solution or by sterilized vaseline. No dangerous metallic forceps were used. The greatest care was exercised to obtain accurate and smooth approximation of the endothelium of the vessels. Finally, we developed a technique which is equally well adapted for arterio-arterial, veno-venous, or arterio-venous anastomoses, and which yields uniformly successful results.

This new technique has been used since August, 1905. Numerous arterio-venous anastomoses and transplantations of veins have been successfully performed. Union of the walls of an artery and a vein to each other may be made without the subsequent occurrence of hemorrhage or stenosis.

Modesty should prevent, but I am unable to refrain from remarking in passing that it is a singular fact that up till the time Carrel and I engaged in the work together he reported that his experiments did not always

[1] *Interstate Medical Journal*, XV., No. 6.

[2] The italics used in the above quotations are my own.

[3] The work in this laboratory has been conjointly performed.

yield good results, and that *our results almost from the beginning of our work together were excellent!* Indeed, so far as I have been able to determine, Carrel working first with Berard, then with Morel in France, and later by himself in Dr. Carl Beck's laboratory in Chicago, claims only one permanently successful result.[4] This was an arterio-venous anastomosis made with Morel between the jugular vein and carotid artery of a dog. The animal was under observation but a short time and ultimately was lost, so no direct examination of the result was made. But in all probability it would have remained good. He attributed his earlier unsuccessful results to "poor asepsis," but since I have observed that moderate infection is of slight importance as regards the result which such blood vessels as he used are united by the methods perfected by him and myself, this, it would seem, is not the full explanation. As to priority, it gives me great pleasure to express my high regard for Dr. Carrel's persistence in the face of a long series of unsuccessful operations and I desire to in no way endeavor to attach any of the credit he deserves for this devotion.

Many experimenters have endeavored to sew together openings in blood vessels and to unite them end-to-end. To verify this statement one need only to refer to a modern work on surgery, *e. g.*, "American Text-book of Surgery," 1903, p. 292. Murphy, himself the author of a successful method of end-to-end anastomosis—a method used successfully on man—gives a short but valuable summary of the literature,[5] beginning with the successful suture of a longitudinal incision in an artery in 1762 by Broca.

The dubious distinction of *priority* which it would appear is the goal sought by some of our contemporaries, presents slight attraction to the sincere investigator whose reward largely is the consciousness that his labors may in the end add a line to the encyclopedia of science.

[4] See *Surgery, Gynecology and Obstetrics*, March, 1906, II., p. 269.

[5] "Resection of Arteries and Veins Injured in Continuity—End-to-End Suture," *Medical Record*, January 16, 1897.

In addition to the references given above a list of the more important papers published conjointly by Carrel and the writer is appended:

"Functions of a Transplanted Kidney," SCIENCE, N. S., October 13, 1905, XXII., p. 473.

"Extirpation and Replantation of the Thyroid Gland with Reversal of the Circulation," SCIENCE, N. S., October 27, 1905, XXII., p. 535.

"Transplantation Biterminale Complète d'un Segment de Veine sur une Artère," *Comptes Rendus Heb. des séances de la Société de Biologie*, Novembre 17, 1905, LIX., pp. 412–13.

"Successful Transplantation of both Kidneys from a Dog into a Bitch, with Removal of both Normal Kidneys from the Latter," SCIENCE, N. S., March 9, 1906, XXIII., pp. 394–5.

"Results of a Replantation of the Thigh," SCIENCE, N. S., March 9, 1906, XXIII., pp. 393–4.

"A New Method for the Homoplastic Transplantation of the Ovary," SCIENCE, N. S., April 13, 1906, XXIII., p. 591.

C. C. GUTHRIE
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WILLIAM KEITH BROOKS

TO THE EDITOR OF SCIENCE: Allow me to call attention to several errors that appeared in my sketch of William Keith Brooks, in SCIENCE, for the fourth of December, 1908. On page 777 Brooks's college education is ascribed to his own exertions, but in fact not only did his parents put no obstacles in his way but his father sent him to Hobart College and later to Williams College. It was only his subsequent, post-graduate training, that required Brooks's own labors. Moreover, it is doubtful if his experience in his father's counting-office was not after he had finished his college education. Again on page 778 Hobart College is confounded with the De Vaux College, a school for boys near Niagara Falls. It seems that Brooks was a student at Hobart, entering in 1866, and leaving at the end of his sophomore year to go to Williams College, where he graduated in 1870. *Subsequently* he taught, as one of the masters, at De Vaux College, from 1870 to 1873. On the same page Tyron should read Tryon and H. Tuttle, Albert H. Tuttle.

E. A. ANDREWS

SCIENTIFIC BOOKS

A Key for the Determination of Rock-forming Minerals in Thin Sections. By ALBERT JOHANNSEN. New York, John Wiley & Sons. 1908.

This key has been prepared, as the author states, for the reason that tables for the optical determination of minerals in thin sections have heretofore been made of secondary importance in text-books. Most of the books on this subject, while admirable in their way, are of more use to trained mineralogists than to beginners, this being due principally to the absence of "classification."

The book is divided into four parts: Part I. treats of introductory optics, measurements to be made with the microscope and the methods of recognizing the common optical characters of minerals. Part II. takes up the general discussion of the relations between the different members of the common groups of minerals. Diagrams are here given to assist in the determination of the species in the pyroxene, amphibole and feldspar groups. The part treating of the feldspars is particularly elaborate, giving fourteen methods of investigation. Part III. (415 pages) gives an explanation of the tables and contains a very elaborate scheme for determination, based on a systematic identification of the fundamental optical characters of the minerals in question, the minerals with similar optical characters being grouped in the same part of the scheme. Following the description of each mineral are given the distinctions between it and other similar minerals. Part IV. contains tables of mean indices of refraction, maximum birefringences, specific gravities, and also lists of minerals by crystalline system and "habit." A summary is appended of the optical characters of the minerals in alphabetical arrangement, which is very convenient, as it does away with the necessity of remembering the author's special arrangement, a universal fault to be found with other tables.

This book represents a very elaborate and painstaking collation of the important optical and crystalline characters of some one hundred and sixty-four rock-forming minerals, and, for the first time in the literature of the subject, the minerals have been arranged in a way for systematic optical determination. A further advantage lies in the fact that these optical and crystalline characters are always recorded in the same order and that paragraphing is freely used. The author has made the introductory discussions on optics and determination of optical characters as simple as possible, but has given detailed footnotes referring to more complete theoretical discussions of the underlying principles. Standard authorities have been consulted in the preparation of the general data, but the tables might have proved more useful had authorities been cited.

The scope of the work along optical lines is similar to that covered by Penfield and Brush in their "Tables for Blowpipe Determination of Minerals."

The scheme is sufficiently elastic to provide for mistakes likely to be made in the determination of some of the optical characters, as for example, extinction angles. Minerals with small extinction angles (under 5°) are found in two places of the scheme, both with minerals with inclined extinction and with those with parallel extinction. The micro-photographic cuts of interference figures are very good and many of the tests are explained with the aid of detailed diagrams, so that they may be easily and quickly made. A good color chart of the interference colors (after Lévy and Lacroix) is appended.

The value of the book might have been increased by a more detailed description of the types of petrographical microscopes and their common adjustments. Also the suggested indenting of the pages of the text is a matter of much trouble and an arrangement providing for this being done by the printer would certainly prove of great advantage in subsequent editions.

L. McI. L.

Southern Agriculture. By F. S. EARLE. Pp. vi + 297. Containing 9 half-tone plates, many text cuts, and full index. New York, The Macmillan Co. 1908.

This work has many points of merit to commend it to the schools of the south and will no doubt be widely used as a text-book. It is divided into two parts, the first dealing with general considerations, such as climate, soil, soil management, soil improvement, the growth of plants, insects and diseases, and closes with a chapter on farm policy and management. The second part treats of the chief southern agricultural crops, including grasses and forage crops, fiber crops, tobacco, coffee, fruits, nut crops and forestry, and closes with a short chapter on domestic animals.

In the chapter on management of the soil, valuable suggestions are given on the use of farm implements, a part of agriculture so often neglected by writers. A little farther on, soil improvement is well treated and the relation of leguminous crops to same, with recommendations of certain leguminous crops for certain kinds of soil. The student is shown the relation of the plant to the soil, and the functions of the different parts of plants. The chapter on spraying and sprays, containing formulæ for different sprays, is well arranged and almost indispensable, inasmuch as crop enemies such as insects and fungi are so rapidly increasing in the south where heat and moisture are so conducive to their welfare.

In treating of individual crops in the second part of the book, the method is to be commended. First the author deals with the crop itself, and then as far as consistent with the nature of the plant, takes up a detailed study in each individual crop, of soil and climate, manuring, methods of planting and cultivating, and harvesting. This uniformity of method gives the pupil the benefit of comparing one crop with another on any of these points suggested.

Just what is meant by southern agriculture is not suggested by the author, but from the numerous references to the tropics and to tropical agriculture, it would seem that they are included in the title of the book. Possibly it would have been better to have gone a little further into the general and specific methods of tropical agriculture, and have given the book the title "Southern and Tropical Agriculture."

There seems to be very little excuse for devoting twenty-four pages to sugar cane and only sixteen to cotton, when the author states that cotton is our "greatest commercial crop," also, only twelve to corn, "the most important crop." A little more space should have been devoted to the best methods of improving cotton and corn, if not any less to sugar cane, especially after the above statements. The space devoted to an explanation of the poor methods of cotton planting on pages 175 and 176 could have been better used by giving better methods and emphasizing the necessity for level cultivation of cotton. It is a better paying business, for instance, to lay off new rows for your cotton than to follow cotton after cotton, as suggested in the text, notwithstanding the fact that its danger is hinted at on the same page.

There is no chapter devoted to the dairy and live-stock industry, though the importance of it is suggestod in three places in the book. Stock feed can be raised very cheaply in the south and the cost of keeping stock is reduced to the minimum. No costly shelters are required, and it is possible to arrange your pastures so that your stock can graze ten or eleven months in the year. Besides, at present we ship from the south millions of dollars' worth of cotton-seed meal annually, to be used for stock feed in other parts of the world, instead of using it as we should, first through live stock to increase the beef and butter production of the south, and secondly in the form of barnyard manure to fertilize the land with. It is believed that the book would have been worth more to the schools of the south, if a good, lengthy chapter on the live-stock industry had been included.

In conclusion, it seems that the author is more at home in his studies of tropical agriculture, and though he has done excellent work, many parts of the book read as if the information given were not first hand. For instance, there is a freshness and an air of confidence in those parts that treat of diseases and remedies, and the botanical features of special crops that are conspicuously lacking

in the parts devoted to manuring and cultivating.

R. J. H. DeLoach

Bermuda in Periodical Literature, with occasional References to other Works. A Bibliography by George Watson Cole. Pp. ix + 275. Printed for the Author. 1907.

This volume contains 248 pages of references and 24 pages of index; the references are arranged alphabetically by publications, the index by subject and author, thus providing easy access to the contents. Each title is followed by a brief note which gives the characteristic features of the article, and these notes constitute a feature quite as valuable as the references themselves.

On the last page is a list of references to libraries in which a copy of the work cited was found. By the choice of fonts and skillful use of insets the various items of a citation are clearly differentiated to the eye, and the page is made attractive. The range of periodicals cited is very wide, and they cover not only newspapers and magazines, but proceedings of learned societies. The range of subjects is unrestricted, and taken together, they comprise nearly all that has appeared concerning history, description and natural history for the last fifty years. The last division has been especially well done, for it became apparent to Mr. Cole, soon after beginning his compilation, that Bermuda has been a favorite field for the geologist, the botanist and the zoologist. In the preface he says:

> Bearing this in mind, a special effort has been made to render the record of their labors as complete as possible. In order to do this, references are made to some works which are not periodicals, mostly, however, by authors who have also made contributions to periodical literature concerning the flora and fauna of those islands.

The result of this special effort has been to provide in one volume a reference to nearly every addition made to the flora and fauna since (and including) the *Challenger* expedition. The value of such a gathering to the botanist and the zoologist can not be overestimated, and this compilation, moreover, has proved to be exact and accurate at every point tested by the reviewer. Some idea of the manner of treatment may be gathered from the fact that nearly fourteen pages are required for the direct excerpts from the *Challenger* report, to say nothing of the entries of articles appearing elsewhere on the *Challenger* material. The references on birds go back to 1849 and come down to 1904; those on flora extend from 1700 to 1906; those on geology from 1833 to 1906. Moreover, the index takes account of the changes in nomenclature (*e. g.*, "Leptocardians, Goode (1877), 19. *See also* Asymmetron"), so that the difficulties due to this unfortunate obstacle are minimized.

While natural history is amply represented, the other subjects are not neglected. Twenty-four pages are given to citations from the New York City daily papers and seven pages to those from the London *Times*. The total number of citations is 1,382.

Taken as a whole, the work is a masterpiece of bibliography. To take up the chronicles of a somewhat remote island and set them down in order in these days of wide-spread publication seems a task almost impossible to perform in a creditable manner, and a thankless task when done. Mr. Cole's work is excellently well done, and he will earn the hearty thanks of every botanist and zoologist who has occasion to use the volume. In view of the forthcoming tercentennial celebration to be held in Bermuda next year, the colony may well thank Mr. Cole for so handy a volume of reference.

C. L. Bristol

SCIENTIFIC JOURNALS AND ARTICLES

Terrestrial Magnetism and Electricity for December contains the following articles: "Solar Magnetism," by W. J. Humphreys; "Note on the Magnetic Effect of Winds," by W. J. Humphreys; "Solar Magnetic Fields and the Cause of Terrestrial Magnetism," by W. Sutherland; "Note on Sutherland's Article," by G. E. Hale; "On the Probable Existence of a Magnetic Field in Sun-spots," by G. E. Hale; "On the Distribution of Magnetism over the Earth's Surface, II.," by P. T. Passalskij, translated by Paul Wernicky;

"Results of Recent Magnetic Observations in Mexico (1906–8)," by Felipe Valle; "The Magnetic Storms of September, 1908," by O. H. Tittmann; "Letters to Editor," "Notes," etc.

THE NEWEST ANCIENT MAN

Yesterday (December 14) before the Academy of Sciences Professor Edmond Perrier, director of the Museum d'Histoire Naturelle exhibited a skull to which he ascribes a great importance. The skull, together with other parts of the skeleton (bones of the upper and lower limbs), was found about six months ago by two abbés (Bouyssonie and Bardon) in some excavations being made near Chapelle-aux-Saints in the Corrèze.

The rock strata in which these bones were found are, according to M. Perrier, of middle Pleistocene age.

The skull is that of a man of extremely low type, an ape-man, or perhaps of a man-ape of greater cranial capacity than any at present known. This great cerebral development leads M. Perrier to consider it, on the whole, a human skull. But the very thick, low cranial dome, the flattened forehead and pronounced orbital ridges, the broad nose separated from the forehead by a deep furrow, and the much elongated snout-like maxillaries combine to give the skull a marked gorilla-like seeming. The brain cavity, however, is as already said, very much larger than that of the gorilla or any other present-day anthropoid.

The limb bones are curved and present a conformation which indicates that this Pleistocene man walked more often on all-fours than in an erect position. The bones seem to be fairly intermediate between those of a man and those of the present-day anthropoids.

Altogether Professor Perrier (whose scientific standing gives his opinions in the matter high authority) believes that he has in his hands—the specimens have been purchased by the museum—remains much more ancient than those of Neanderthal or Spy, and actually representing a type intermediate between Pithecanthropus and present man.

Those interested should watch for the more detailed and authoritative report of Professor Perrier's account which will appear in the *Comptes Rendus*.

VERNON L. KELLOGG

PARIS,
December 15

THE INDIANA UNIVERSITY EXPEDITION TO BRITISH GUIANA

PROFESSOR CARL EIGENMANN, dean of the Graduate School of Indiana University, has just returned from a four months' trip to British Guiana, where he was engaged in the study and collection of South American fishes. He was accompanied by S. E. Shideler as a volunteer assistant. Professor Eigenmann is now engaged in a monograph of the fresh-water fishes of tropical America. The trip to British Guiana had three objects. It was intended to collect as many species of fresh-water fishes as possible from one of the South American rivers flowing north; to photograph living fishes, and to collect on the plateau of Guiana.

Fishes were collected near the mouths of rivers from the Berbice River on the east to Morawhana near the Orinoco on the west. In the Demarara River collections were made at Georgetown, at Nismar, near the head of tide water, about sixty miles from the coast, and at Malali, almost thirty miles further up stream at the first rapids.

In the Essequibo River collections were made at Bartica, Rockstone, Crab Falls and the Warraputa Cataract.

For an attack on the Guiana Plateau the Potaro River was selected. It is a tributary of the Essequibo about ninety miles from the coast. There are a series of short cataracts with long stretches of navigable water in between. The first of the rapids are at Tumatumari where extensive collections were made. From the next rapids, near Potaro Landing a path of seven miles brings one above the Ichaura, Aurituk, Cobanatuk and Pakatuk Cataracts to Oangaruma. From here on the trip was continued with the boats and crew of sixteen Indians, generously put at the service of the expedition by Messrs. G. Linnel and

Edward Bovalius of the Essequibo Exploration Company.

Progress above Cangaruma was retarded slightly by fever. A portage at Amatuk and another at Waratuk with two days paddling brought the expedition to Turkeit at the base of a series of Cataracts at the head of which is Kaieteur Fall, the show place of British Guiana. The Potaro here leaps 741 feet from the plateau to the Potaro Gorge below.

A portage of 2½ hours carries one from Tukeit to the Savannah above the falls. Mr. Schideler returned from this point to collect near the coast, while Professor Eigenmann continued with thirteen Indians to Holmia and Arnataima, the first cataract above Holmia.

Thorough collecting was undertaken in the Potaro above and below the Kaietue with the use of hooks, seines, dynamite and most effectively with Haiara, the poison used by the natives in their fishing. The expedition was thoroughly satisfactory although few photographs of fishes could be taken on account of the labor necessary to secure suitable specimens.

It is hoped that it will be made possible to continue the exploration of the Guiana Plateau which sends rivers over heavy falls to the Essequibo, Orinoco and Amazon from around Roraima, possibly the oldest land area of South America.

The bit of most satisfactory discovery is that Gasteropelecus, an aberrant characin, flies. This fish has the most amazing structure for a characin. It possesses huge pectorals, a tremendous "sternum" and pectoral muscles to correspond. It was frequently seen to dart from in front of the boat, float its pectorals while part of its tail and sternum remained in the water and then in the last five or ten feet of its 45-foot flight clear the water. As long as part of the fish remains in the water the pectorals touch the water with each stroke. Not the least interesting fact is that their line of evolution from generalized Characins is indicated by the still-existing genera like Chalceus and Pseudocorynosoma.

SPECIAL ARTICLES

SPECTRUM OF COMET MOREHOUSE

The spectrum of this comet has been under observation here since October 28, with the use of a Zeiss photographic doublet of 145 mm. aperture and 81 cm. focal length, made of "ultra-violet" glass, over which was placed a 15° objective-prism of the same glass and aperture. With an exposure of fifteen minutes the head of the comet then gave a sufficiently strong impression, showing a row of seven knots. With longer exposure the tail could be well traced from some knots until it ran off the plate, at a distance of 3°.

The absence of a continuous spectrum was striking, and on no plate thus far obtained has it been certainly visible. This indicates that during this period the reflected light has been exceedingly weak in both head and tail relatively to the intrinsic light due to the carbon and cyanogen bands.

A very small quartz spectrograph was also attached to the same telescope, and plates having the advantage of a comparison spectrum were obtained on four nights. Twenty-one satisfactory plates were obtained with the objective-prism on eleven dates. All the plates were made by Parkhurst, with assistance, when necessary, from Frost.

The measurements of wave-length are quite uncertain on account of the very small scale of the spectrum with either apparatus—only 2.5 mm. from $H\beta$ (λ 4861) to $H\theta$ (λ 3798) with quartz spectrograph (3.0 mm. with objective-prism)—but we have been surprised at the accordance of our measures on different plates. It is difficult to make settings on the edges of the cometary bands on account of their diffuseness, so that it is often necessary to be content with settings on the centers of the knots.

We regard the identification as certain for the third and fourth carbon bands (edges at λ 5165 and λ 4737) and the first, third and fourth cyanogen bands (λ 4601, 3883, 3590). These carbon bands are two of the three bands characteristic of cometary spectra, and often, perhaps generally, ascribed to a hydrocarbon. The other one, at λ 5635, did not affect our

plates. We have measured other bands as follows:

Extending from about λ 4290 to λ 4250 with center at λ 4267.

Extending from λ 4030 to λ 3995 with center at about λ 4015.

Center at about λ 3915, less refrangible edge at about λ 3920.

Center at about λ 3795.

Those at λ 4267 and λ 3920 fall in the position of the only lines (as contrasted with bands) in the carbon spectrum in this region, but we do not regard this as an identification.

The tail extends out in very different intensities from some of the knots: thus λ 4737 has only a small extent of tail, but the knots at λ 4737 and 3883 give the appearance of a greater development than the others in the direction away from the tail, *i. e.*, toward the front of the head.

Otherwise the spectral images of the tail exhibit the same general structure shown by direct photographs of the comet on the same nights. No marked changes in the chemical constitution of the tail have been observed by us between October 28 and December 1. It is interesting to note, however, that this simple apparatus would have been competent to show any differences in constitution such as called for by Bredichin's theory, had it been used on September 16, when the direction of the tail changed through a large angle from its direction before and after that date.

A detailed account of our study of these plates, with reproductions of some of them, will appear later in the *Astrophysical Journal*.

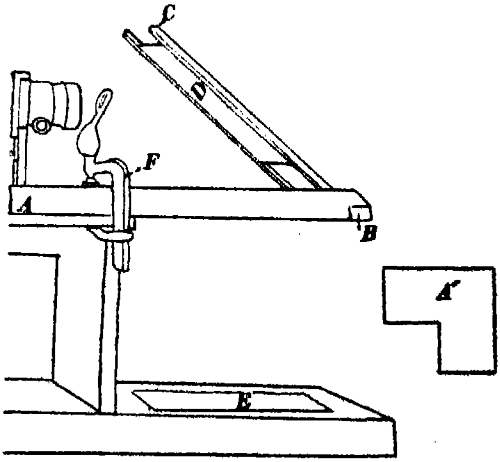
EDWIN B. FROST,
J. A. PARKHURST

YERKES OBSERVATORY,
December 2, 1908

A SIMPLIFIED APPARATUS FOR DRAWING WITH THE AID OF THE PROJECTION MICROSCOPE

IN a number of laboratories there are in use devices for drawing by the aid of a projection lantern. These vary in complexity from a simple easel at which is traced the direct projection of the image, to comfortable dark rooms especially equipped for this work and with an apparatus for reflecting the image to the table at which the artist sits. The first type is inconvenient and fatiguing, the second, on account of both the expense and the space demanded, is not available in every laboratory. It was Professor S. H. Gage's complete and excellent equipment that suggested the here-described simple device, to be used in the lecture-room where the projection outfit stands, without duplication of apparatus or requirement of extra space.

It consists merely of a rod holding a mirror at an angle of exactly 45°, clamped to the stand which carries the projection lantern or the microprojection outfit. With this in use one may sit at a table in a darkened room and trace the projection of microscopic preparations, lantern-slides or of photographic negatives. A glance at the diagram will show the extreme simplicity of the parts involved.



A, shown also in end-section at *A′*, is a piece of wood two by two inches and about three feet long, grooved by means of a rabbet plane so as to clamp firmly to the lantern table (see *A′*). The arm *B* bears the two grooved strips *C* which carry at an angle of 45° the mirror *D*. This casts the image on the drawing surface *E*, where it may be traced with ease.

The magnification depends directly upon the distance of the drawing board from the mirror. Thus if the enlargement is two times when line *E–D* is ten inches, the image will be enlarged four times if line *E–D* is twenty inches.

Magnification also depends, of course, upon the distance of mirror from the lens.

The apparatus has been especially helpful in making rapidly, and to scale, accurate drawings of insect wings, mouth-parts and the like. One student, who was also working in vertebrate zoology, found it of the greatest service in making from negatives enlarged drawings of the arrangement and distribution of the scales of various reptiles. But in addition to this outline work it is also perfectly feasible to use it with more detailed drawings from microscopic preparations if the room be well darkened. It is quite possible that a similar device has long been in use by others, but I have failed to find any mention of it and I have, therefore, thought that this description might be of aid to some.

Wm. A. Riley

SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 655th meeting was held November 21, 1908, President Bauer in the chair. Three papers were read at this meeting, as follows:

The Radiation Laws of Metals: W. W. Coblentz.

A knowledge of the laws governing the radiation of metals with variation in temperature is of interest in connection with the numerous speculations offered to explain the great light emissivity, *i. e.*, the high luminous efficiency of the new incandescent lamps with metal filaments.

The speaker described some results obtained in an investigation of the most important so-called constant, a, of the type which obtains for a "black body" in which $a-1=4$, in Stefan's law of total radiation. The substances examined were tungsten, tantalum, osmium, platinum and several types of carbon filaments, usually in the form of 110-volt incandescent lamps. The spectral distribution of energy was measured with a bolometer.

It was found that the so-called constant, a, decreased with rise in temperature, and in all cases higher in value than that of platinum.

It seems to be a physical property of metals to have a low reflecting power in the visible, and especially in the ultra-violet, part of the spectrum. Throughout the infra-red the reflecting power of metals is uniformly high. The low reflecting power in the visible spectrum causes an abnormally high emission in this region, which, in connection with the high values of the so-called constant, a, accounts for the high luminous efficiency.

Although it seems to have been overlooked heretofore, it is obvious that the so-called constant, a, must decrease in value and approach that of a "black body," otherwise a point would be attainable at which the radiation is greater than that of a black body at the same temperature.

From the results obtained it is evident that the spectral emissivity function of metals must be far more complex than that given in the Wien equation. Since the emissivity is a function of the reflecting power, which is a function of the refractive index and of the absorptive coefficient, which, in turn, are functions of the temperature, the wave-length and the electrical conductivity, it is evident that the spectral emissivity equations must contain factors which will take account of these phenomena.

Determination of Flexure of Pendulum Supports by the Interferometer: W. H. Burger.

In measuring the force of gravity by means of a swinging pendulum, the observations are necessarily made under varying conditions, and the period of vibration of the pendulum is consequently affected by many causes, and corrections have to be applied before the value of g can be ascertained. One of the important corrections results from the elastic yielding of the pendulum support. Several methods have been used to measure the flexure of the pendulum support and to ascertain its effect upon the period of the oscillating pendulum. Each of these methods contains some doubtful assumptions, and to avoid which the new plan of employing the interferometer for measuring the absolute displacement due to flexure of pendulum support was devised by Messrs. Hayford and Fischer, of the Coast and Geodetic Survey. The instrument used is a modified form of the Michelson interferometer. In observing, the instrument is separated into two parts, the main body of the instrument, and the mirror attached to the pendulum case, each being carried on entirely separate supports.

The experiments carried out by the speaker included tests of flexure of both pendulum case and of the pier upon which the case was mounted. The displacements were found to be movements of rotation. For comparison the static force method was also used in the experiments. Measurements of displacement were made with the pendulum case mounted with various substances between the

foot plates and pier. The investigations with the interferometer are still in progress, but it was the speaker's belief that the results so far attained should show that a distinct advance will be made in gravity observations when the flexure is determined by means of the interferometer.

Construction of Scientific Instruments and Their Adjustment: F. E. WRIGHT.

The paper dealt with the importance to science of knowing the degree of accuracy of scientific results, and the influence which the construction of the instrument may exercise in scientific investigation.

Under the head of informal communications, W. J. Humphreys spoke of the possible magnetic effect on the earth of wind storms, and of the recent discoveries made at Mt. Wilson regarding sun-spots.

R. L. FARIS,
Secretary

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY

AT a meeting held on November 16 at the American Museum of Natural History Professor D. W. Hering was nominated for chairman of the section and a vice-president of the society for the ensuing year. Professor Wm. Campbell was reelected secretary. The following papers were then presented:

On the Electrolytic Refining of Iron: E. F. KERN.

The previous work on this subject was reviewed; first, electroplating iron upon the surface of engraved copper plates to obtain a hard facing; then the work of Burgess and Hambuechen, of Gee, of Neuburger and von Klobukow, of Skrabel, of Maximowitsch and of Cowper-Coles. The electrolytes which have been most generally used are neutral solutions of ferrous sulphate or ferrous chloride containing respectively the sulphates or chlorides of ammonium. Smoother deposits were obtained by the presence of magnesium sulphate in an electrolyte of ferrous ammonium sulphate; by stirring the electrolyte; at a temperature of 60–70° C. Oxidation retarded by addition of glycerine. Precipitation of basic salts prevented by adding just sufficient acid to clear the solution. The iron deposited was a hard, brittle, crystalline mass, over 99.9 per cent. pure.

From experiments carried on in the department of metallurgy, Columbia University, it was found that neutral ferrous fluosilicate electrolytes are not suitable, as they are slowly decomposed with the separation out of silica.

Good deposits were obtained from neutral electrolytes containing either 8 per cent. iron, as $FeSO_4$, or 6 per cent. iron and 3 per cent. sodium, as sulphates, or 8 per cent. iron and 4 per cent. sodium, as chlorides. With a current density of 10 to 20 amperes per square foot and a temperature of 50° C., the electromotive force for the first solution was 0.8 to 0.95 volt, for the second 0.5 to 0.85 volt, for the third 0.4 to 0.5 volt. The paper concluded with a discussion of the costs of electrolytic refining of iron.

W. Campbell read a paper on the "Use of Metallography in Certain Problems in Concentration." The unsuccessful attempts to concentrate the nickel in nickeliferous pyrrhotites were probably due to the fine condition of the pentlandite. Slides illustrating the structure of ores from different localities were shown. The structure of certain magnetic lead ores from Idaho was seen to be a fine-grained complex containing magnetite, quartz, calcite and other gangue, blende and galena, which were deposited in about that order. Magnetic separators applied to the zinc-lead middlings from the jigs yielded a lead-rich concentrate which was taken out by the magnets. The structure of a zinc ore at ground-water level, from New Mexico, was shown to be mainly rosettes and compact masses of specular hematite with zinc blende in the interstitial spaces. The following order was indicated: pyrite, hematite, chalcopyrite, blende and a little gangue. The difficulty in concentrating the zinc was due in part to structure.

W. Campbell read some notes on a "Visit to the Collieries and Iron and Steel Plants of Nova Scotia," illustrated by numerous lantern slides. The visit was made with the Canadian Mining Institute during the summer. The collieries of the Dominion Coal Company at Glace Bay were first seen, then the plant of the Dominion Iron and Steel Company. Piers with mechanical unloaders for ore from Newfoundland; four blast furnaces; ore beds for winter stock, blowing engines, etc.; two Bessemer converters, ten open-hearth furnaces; rail mill, rod mill; coke ovens and coal-washing plant. At North Sydney the Nova Scotia Steel and Coal Company has coal and ore piers, with two steam Wellman Seaver Morgan ore unloading cranes. Wabana ore from Bell Island, Newfoundland, averages 55 per cent. Fe. At Sydney mines the various collieries were visited. Here are coke ovens and coal washer, one blast furnace (200 tons a day), three forty-ton basic open-hearth furnaces and one rolling furnace of

180 tons used as mixer. Ingots are sent to the rolling mills at New Glasgow.

WILLIAM CAMPBELL,
Secretary

COLUMBIA UNIVERSITY,
NEW YORK

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

THE thirtieth meeting of the society was held at the College of Physicians and Surgeons, October 21, 1908, with President Lee in the chair.

Members present: Alsberg, Atkinson, Auer, Banzhaf, Burton-Opitz, Crile, Dakin, Ewing, Famulener, Flexner, Gies, Harris, Jobling, Joseph, Kast, Lee, Levene, Levin, Lusk, Mandel (A. R.), Meltzer, Meyer, Morgan, Noguchi, Opie, Park, Pearce, Shaffer, Terry, Van Slyke, Weil, Wells, Wolf.

Members elected: C. C. Guthrie, E. P. Lyon and Mazyck P. Ravenel.

Scientific Program[1]

"Studies on the Chemistry of Anaphylaxis," H. Gideon Wells.

"Further Observations on the Clinical Aspects of Hemolysis," George W. Crile.

"The Behavior of Alanin in Metabolism," A. I. Ringer and Graham Lusk.

"An Important Source of Error in Heller's Test for Urinary Protein," William Weinberger (by invitation).

"A Clamp for Direct Transfusion of Blood" (a demonstration), Isaac Levin.

"The Further Separation of Antitoxin from its Associated Protein in Horse Serum," Edwin J. Banzhaf.

"Multiple Tumors in Mice," J. W. Jobling.

"On Plastein," D. D. Van Slyke and P. A. Levene.

"The Action of Bile and Some of its Constituents upon Intestinal Peristalsis and the Circulation," Isaac Ott and John C. Scott.

"The Uric Acid Excretion of Normal Men," Paul J. Hanzlik and Philip B. Hawk.

"Hemolysins in the Sera of Carcinoma and Syphilis," S. Peskind (by invitation).

[1] Authors' abstracts of the papers read before the Society for Experimental Biology and Medicine are published in the *Proceedings of the Society for Experimental Biology and Medicine.* A number is issued shortly after each meeting, and costs twenty cents a copy. Copies may be obtained from the managing editor, William J. Gies, 437 West 59th Street, New York.

"The Effect of Instilling Adrenalin Chloride into the Mammalian Eye," W. H. Schultz (by invitation).

"Successful Canine Infection with Cultures of *Leishmania infantum* (Ch. Nicolle)," Frederick G. Novy.

"New Apparatus for Use in Metabolism Work" (a demonstration), William J. Gies.

WILLIAM J. GIES,
Secretary

THE BIOLOGICAL SECTION OF THE ACADEMY OF SCIENCE AND ART OF PITTSBURG

AT a regular meeting of the section on December 1, Mr Richard R. Hice, of Beaver, Pa., spoke on the "Preglacial Drainage of Western Pennsylvania." Mr. Hice gave a concise summary of the work of Carll, White, Foshay, Jillson, Leverett, Campbell and Hice on the drainage of this part of the state. As outlined by him, the history of the region has been as follows: In the late Tertiary there existed a fairly well-developed river system draining northward into the Erie basin through the upper Ohio and Beaver valleys. This system was destroyed by the advance of the Kansan ice, which dammed the rivers, forming Lake Monongahela. The water was thus raised to such a height that it spilled over the divide below Wheeling, and the formation of the present Ohio was begun. A period of uplift followed, during which the rivers draining toward the southwest cut their channels far below the present level of the river bottoms. During the later part of the Wisconsin ice-advance and following the retreat of the ice, there was a settling of the land and the valleys were filled to a point above the present stream level with glacial débris. At the present time the streams are engaged in lowering their beds in these sands and gravels.

PERCY E. RAYMOND,
Secretary

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

THE 180th meeting of the society was held in Chemistry Hall on Tuesday, November 10, 1908, 7:30 P.M. The program was as follows:

"A Trip to Europe for Geographical Study" (illustrated with lantern slides), Professor Collier Cobb.

"A Rapid Method for Determination of Oil in Cotton-seed Products," Professor Chas. H. Herty.

ALVIN S. WHEELER,
Recording Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 8, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE BALTIMORE MEETING

The Baltimore meeting of the American Association for the Advancement of Science and the affiliated national scientific societies has never been equalled in size and importance by any gathering of scientific men in this country or indeed elsewhere. It might have been expected that the meetings held in the great centers of population last year and the year before would have set the high water mark of attendance for some years, but the registration at Baltimore was even larger than at New York or Chicago, and the percentage not registering was greater than ever before. Registration can only be regarded as a habit or duty, as it confers no privilege, the list not even being printed. Of the 300 chemists at the New York meeting only 106 registered; at Baltimore, where the chemists met in a distant part of the city with an attendance of about 400, perhaps not more than 50 registered. The actual registration of members of the association was 1088; the attendance at the meeting can only be guessed, but it may have been in excess of 2,500.

Size is not in itself significant; it may be an advantage or it may be a nuisance. But in so far as the growth of the convocation week meetings means an increased number of scientific workers in this country and a willingness on their part to cooperate, it is grati-

fying and important. A very large meeting has for those in attendance certain advantages and certain disadvantages. It is irritating not to be able to attend the conflicting meetings of nearly equal interest and not to be able to converse at leisure with friends and acquaintances. It should, however, be remembered that if the different societies were meeting in different cities, it would be still less possible to attend the meetings that one would like to attend and to see the friends that one would like to see. It might be possible for the sciences devoted to the biological sciences to meet in one city and for the sciences devoted to the physical sciences to meet elsewhere; perhaps for the geologists and the philosophers to meet by themselves. But in such a case what are the biological chemists, the biometricians, the students of evolution, the cosmical physicists, the geographers, the psychologists, etc., to do?

The real conflict is not between the chemists and the zoologists, for example, but within the single science. Thus at Baltimore the Zoological Society of America and the zoological section of the association each had some sixty papers on its program; there were two entomological societies and a society of vertebrate paleontologists in session, the psychologists had a morning devoted to animal intelligence, etc. It is not possible to read and discuss consecutively three hundred papers. The best that can be done is to have sessions of interest to all scientific men, to all biologists, to all zoologists, and then to divide zoology into sections for the reading and discussion of special papers in different departments. The chemists, whose numbers are the largest, have naturally led the way in organization. They have well-organized sections throughout the country for frequent local meetings; they have a summer meeting, usually by themselves, and meet with the other societies in convocation week; they have certain general meetings and then divide into numerous sections; all the papers in chemistry are referred to the American Chemical Society which organizes the joint program.

We may look back with certain regrets to the "good old days" when there were so few workers in each science that they could all be acquainted with one another and with one another's work, or still further back to the age of academies when all the scientific men of a city or county could meet together with common interests; but no one imagines that we can go back to these days, or that it would be desirable to do so. It is like the man who has acquired wealth and power and thinks of past days when life was less complicated and perhaps happier.

> Haply, the river of Time—
> As it grows, as the towns on its marge
> Fling their wavering lights
> On a wider, statelier stream—
> May acquire, if not the calm
> Of its early mountainous shore,
> Yet a solemn peace of its own.

It is of course true that the problems of scientific organization are by no means solved. Some of them may be settled in a satisfactory manner; others may be quite unsolvable. There were at the present meeting needless mistakes on the program,

such as announcing the wrong building for the address of the president and the wrong afternoon for the meeting of the Naturalists; needless dispersion, as in sending the sections of anthropology and of education to large auditoriums at a distance when the lecture rooms of the university would have held and secured larger audiences than were present; needless conflicts, as the programs of the Zoological Society and the Section of Zoology in adjacent rooms. There should be one man thoroughly familiar with the situation and competent to do the best that can be done under the circumstances. We need a secretary of science for the country, not less influential and not less well paid than the secretary of the Smithsonian Institution, who will devote his whole time to the organization of science and of scientific men.

It is quite possible that it would be better to have a convocation week meeting only on alternate years, or even less often, leaving the societies to scatter in intervening years. Or it might be better to divide the association into sections for the eastern, central and western states and hold a joint meeting once in three or in five years. Again it might be well to have an association devoted to the diffusion and popularization of science, separate from an affiliation of the scientific societies composed of professional scientific men. At present the association fails chiefly in the former function. It has a considerable membership in addition to the scientific workers of the country, and there were many sessions at Baltimore that would have been interesting and useful to them, but practically none were present. The association also fails to exert an influence on the general public through the press.

But in spite of difficulties and partial failures, the convocation week meetings have since their establishment in Washington six years ago performed a great service for science and for scientific men. They lead men of science to recognize the community of interest that should obtain; they impress on the general public the weight and magnitude of science; the council, representing the scientific interests of the country, may become an important factor in their advancement. The members of the association, all of whom have the privilege, or at least the opportunity, of reading this journal, have increased from 1,721 in 1899 to over 7,500. All this represents a coordination that may be used effectively for the advancement of science; and whatever forwards the advancement of science is for the benefit of every one.

An account of the business transacted by the council representing the association and the affiliated societies will be given in the report of the general secretary, and this will be followed by accounts of the proceedings of the several sections and of the different societies and by some of the more important addresses, papers and discussions.

The association was fortunate in being welcomed to the Johns Hopkins University and to Baltimore by two of its distinguished recent presidents, and in having as president of the meeting one of the world's most eminent geologists whose

public services extend far beyond the bounds of his science. The admirable address of the retiring president, printed last week in SCIENCE, deserves to be read by every intelligent citizen. It is unfortunate that our daily papers will not follow the example set in Great Britain and print in full an address of this character. Several of the vice-presidential addresses before the sections of the association and several of the presidential addresses before the special societies were of great general interest, while others equally important were technical in character. It would perhaps be desirable if the vice-presidential addresses were always addressed to an intelligent audience rather than to specialists, or at all events if the program would indicate the class for whom each is intended. Among the interesting public lectures may be noted the following: Professor Poulton, of Oxford, on "Mimicry in the butterflies of North America"; Professor Penck, of Berlin, on "Man, climate and soil"; Professor Münsterberg, of Harvard, on "The problem of beauty"; Mr. Bryan, of Honolulu, on "A visit to Mount Kilauea"; Major Squier, U.S.A., on "Recent progress in aeronautics," and Mr. G. K. Gilbert, of the U. S. Geological Survey, on "Earthquake forecasts."

It seems to be scarcely credible, but it is the case, that there were on the program published by the association the titles of more than one thousand papers to be read at the meeting. The great majority of the papers represent research work of a high order. It is sometimes said that the United States is not doing its part in the advancement of science, but this program is a conclusive answer to such criticism. No other country except Germany could hold a meeting in which so many scientific researches maintaining such high standards could be presented as the result of a year's work, and Germany has never held such a meeting.

These papers were in the main special and technical in character, but there were in each science papers containing results of interest to a wide group of scientific men, and in many cases papers and discussions of broad interest to the general public. Among these were the series of addresses before the American Chemical Society, the symposium on correlation in which sixteen leading geologists took part, three general discussions arranged by the botanists, the symposia on college education and life, on physical instruction in schools and colleges, and on public health. Most important of all—perhaps the most significant scientific celebration hitherto held in this country—was the Darwin centenary memorial. Professor E. B. Poulton, the leading exponent of natural selection, came from England to take part, and after his address a series of papers was presented by our leading workers in problems bearing on evolution. The day's proceedings closed with a dinner, at which speeches were made by President Chamberlin, Professor Osborn, Professor Welch, Professor Penck and Professor Poulton.

The meeting next year will be held at Boston under the presidency of Dr. David

Starr Jordan, president of Stanford University. It was recommended that the following meeting be held in Minneapolis. All the affiliated societies will probably wish to go to Boston, and the meeting is likely to surpass in importance even the present meeting. In the following year the special societies whose membership is chiefly on the Atlantic seaboard will have an opportunity to meet separately. In order that the societies may have information in planning joint or separate meetings, the general committee voted that it looked with favor on convocation week meetings in Washington, Cleveland and Toronto, following those in Boston and Minneapolis. The council of the British Association has invited members of the association to attend the Winnipeg meeting next August, the officers as honorary members. In the following summer a meeting will probably be held in Honolulu.

SCIENCE TEACHING AS A CAREER[1]

It is scarcely a serious exaggeration to say that the first thought regarding a teacher which comes to the minds of many estimable people is that of a person who, by virtue of a greater or less assumption of knowledge, is able to occupy a position in which he has frequent long vacations, and in the interim draws a comfortable salary for comparatively short working hours. Such, at least, is the conclusion which may apparently be drawn from the frequency with which these topics are introduced into conversations incident especially to the making of new acquaintances. But these same persons would many times experience a tinge of regret if their sons should choose to adopt this career, and that not because they definitely believe it to be an unworthy or inadequate career, but because they understand very little about it. It is, however, not only true that this supposedly comfortable profession is not overcrowded, but there is evidence that there is a positive dearth of able young men who have both the aptitude and disposition to become teachers. It seems to me, therefore, fitting that we who are interested in the advancement of science should spend a few minutes in the consideration of the conditions which confront a young man who is disposed to become a teacher of science, since the maintenance of a corps of competent teachers is of no less interest to us all, practitioners as well as pedagogues, than are the subjects which they should teach, some of which have been ably discussed in recent addresses.

It is the more appropriate that this question should be considered at this time, since certain presumably authoritative data regarding the compensation of teachers have recently become available, and because the establishment of a section on Chemical Education on the part of the American Chemical Society, the first session of which follows this address, indicates an awakening interest in all that pertains to the education of the chemist and chemical engineer, among which the question of the best means to maintain our supply of capable teachers must assume an important place.

What I shall say will apply doubtless most closely to teachers of chemical science in institutions of college grade, because the conditions under which they labor are most familiar to me; but much that may be said of these teachers is true of those in other sciences which stand in a relation to the arts similar to that of chemistry. A

[1] Address delivered by the retiring chairman of Section C of the American Association for the Advancement of Science, at Baltimore, December, 1908.

great deal has been written on this and similar topics, and I can claim very little originality in the thoughts which follow. I present them in the hope that they may arouse in you, parents, employers, practitioners and teachers, an increased interest in the general welfare of those to whom the teaching of science is entrusted.

It may first be asked, What ground exists for the assumption that there is a present or prospective lack of science teachers? It seems to me that this is indicated by the increasing difficulty which is reported from various institutions and from various departments as having been experienced in filling their instructing corps with the best type of men. I know this to be true in chemistry from my own experience, and from the marked increase in the number of applications for assistants which have come to me from all parts of the country. Unless many of us misjudge the trend of the times, the increasing pressure of competition, making necessary the improvement of old and the devising of new means for the utilization of by-products and waste materials, the greater refinement of products without added cost, demanded by the consumer, and the awakening of the country to the necessity of husbanding its natural resources, all tend to place the chemist and chemical engineer in the forefront of industrial activity, and to make those professions increasingly attractive to our young men, as affording unexcelled opportunities for productive work in a field which at present is not overcrowded. If, at the same time, it is possible by missionary effort to dispel the well-established notion among fond parents that chemistry, pure or applied, is synonymous with explosions and impaired health—an opinion which lacks a statistical basis—the number of young men entering the profession will doubtless increase, but it may fairly be questioned whether what may be designated as the "call of the practical" will not prove increasingly alluring, and our difficulties in retaining able men of the type which we desire to enlist in the service of our institutions, become more and more serious.

Let us face this situation squarely and ask, What is it that makes this "call of the practical" so enticing to ambitious, thoughtful young men who are conscious of their ability to get results, or, perhaps, merely hopeful of a fair measure of success in what they undertake? Money and opportunity are obviously the influential factors; and in the best type of men the latter is likely to be given the greater weight in the selection of a life work. Let us look at these a bit more closely. No one acquainted with existing conditions, if appealed to for advice by a young man facing his choice of a career, would fail to point out to him the probable financial sacrifice involved in the selection of the work of a teacher. Indeed, this is so serious a question that in the case of a young man who may be without financial resources other than his earnings, but is tactful in his dealings with his fellowmen, of high scholarship, and with ability to think independently—just the man who is needed in our corps of teachers—one may well pause before uttering decisive words of counsel which will almost certainly be of great influence in determining the material prosperity of his later life; of greater influence, I sometimes fear, than our knowledge of the past or our prescience really warrants.

How great, in reality, is the financial sacrifice involved in a decision to enter the teaching profession? Data regarding the compensation of teachers in institutions of college grade have recently been made public by the Carnegie Foundation for the Advancement of Teaching in its Bulletin Number Two, on "The Financial Status of

the Professor in America and Germany." In view of the unusual opportunity possessed by the Foundation for the gathering of authoritative data, the figures presented merit attention. No distinctions are made between teachers of science and those in other departments, but, considering salaries only, it does not appear that marked differences exist, and it is probable that the average salaries as there given may be taken as being also representative of those of science teachers. Some of the more relevant statements are as follows: Considering one hundred and three institutions in the United States and Canada which have an annual salary budget of \$45,000 and over, the average salary of a full professorship ranges from \$1,350 to \$4,788. Only eight institutions report an average below \$1,800, and only nine an average above \$3,500. Half of these institutions average less than \$2,200. Taking them all into account, the average appears to be close to \$2,500, but there are more below than above this figure. Individual salaries apparently vary from about \$500 to \$8,000, both being, however, exceptional.

The average salary of an assistant professor is about \$1,600 (half of the institutions pay less than \$1,500); and the salary for the grade of instructor averages a little over \$1,000.

Closely linked with the amount of the salaries paid is the question of the period in the teacher's life when the various amounts may be expected to be obtainable. On this point the statement in the bulletin, based on the available data, is this:

A man acceptable to these institutions for a position worth \$1,250 will be on an average 28 years old; a man appointed to a position worth \$1,750 will be on an average 31 years old when appointed to it; one appointed to a position worth \$2,250 will be on an average 33 years old; one appointed to a position worth \$2,500 or over will be on an average 34 years old.

And elsewhere it is stated that appointments to positions carrying salaries of \$3,000 and upward are not usually made before at least 35 to 39 years of life have been completed.

It is interesting to note in passing that the data from fifty-four additional institutions having salary budgets below \$45,000 annually, indicate that the average salary of a full professorship in them is \$1,800, and that this is reached by men when about 33 years of age.

The average salary of an assistant approximates \$500. It is, however, properly emphasized that the period of service as assistant is essentially one of apprenticeship, during which the incumbent gains much more than is represented by the monthly salary check. Indeed, it is my own conviction that a year of service of this character is, to a right-minded young man, nearly the equivalent of a year of post-graduate study, and affords an experience which is valuable, whether the career ultimately chosen is that of a teacher, or lies in the commercial field.

In order to determine whether, or by approximately how much, the teacher is at a disadvantage as compared with others of equal age and training in other occupations, information was collected by the Carnegie Foundation which is to the effect that the average competent lawyer and competent engineer, after being out of the professional school about eight or ten years (thus approximating the age at which a full professorship with an average salary of \$2,500 is attained) would be earning in New York between four and five thousand dollars a year. A physician might earn somewhat more. The average professor's salary at Columbia University is \$4,289, while that of the College of the City of New York is \$4,788; but, for special reasons, these averages are said to be abnormal. The corresponding figure for Stevens Institute

of Technology is $3,200, and that for Brooklyn Polytechnic Institute is $2,783. It appears, then, that the average college professor at 34 is receiving a less return than his contemporary in other professions by perhaps $1,000 per year, although there may well be individual instances in which there is little disparity. But this is not the main issue; for, as is pointed out in the bulletin referred to, it is at this point that the divergence in the financial rewards begins to increase rapidly. The salary of the full professorship, reached at 34, represents nearly the limit of the earning power of the encumbent if, as is so often true in our institutions, his entire energies are consumed in his institutional service, unless perchance he occupies some position carrying with it special administrative responsibilities. His colleague without the walls of the college has, on the other hand, also just entered upon his most productive period, and may reasonably hope to see his income increase into the tens of thousands, permitting him to maintain a comfortable home and affording him means to meet the growing expenses incident to the education of his children. So far, then, as young men are influenced by the maximum financial rewards and prizes attainable, it must frankly be admitted that, at present, the teaching profession is at a disadvantage.

But I am personally disposed to believe that such difficulties as exist in securing and holding able men as teachers of science are less the result of the comparatively small maximum returns which may be expected when the final stage in professional promotion has been reached, than because of the depressing conditions which confront them during the long period which now elapses between the attainment of salaries of $800 to $1,000, and a salary of $2,000, a period which, in the larger institutions is probably rather more than six years. The young teacher's apprenticeship as assistant or junior instructor is over, and he is anxious to feel that his long period of study and development is bringing him an adequate return, and he hears his classmates tell of bridges built, factories started, laurels won, and salaries raised—sometimes with an all-too-thinly veiled suggestion that he has chosen the less worthy rôle—and he longs to join those who can boast of material successes. To this is often added the proper desire for a home of his own. Or perhaps the home has been established, when there must be a struggle to provide those comforts (not luxuries in an extravagant sense), which his temperament and training lead him to desire, which his institution and his community tacitly expect of him, and which above all, would make of him a man of growing refinement such as we are increasingly in need of in our teaching ranks. Helpful and necessary as it is to increase the salaries of the higher paid professional positions as soon as this is possible, I believe that there is a still more urgent need that the salaries of the junior grades should be earlier lifted to a point at which the strain of anxiety is removed and moderate comfort and congenial surroundings are made possible. This is, of course, mainly true of our larger institutions, or those situated in communities where the cost of living is now so sadly out of proportion to the amounts on the salary lists, but it may be questioned whether the ratio of income to outgo is essentially better in smaller institutions and places. I believe that this is a matter which all of the college authorities should consider in order that this period may prove less repellent and that the rounding out of the nonprofessional side of the science teacher, which is often so large a factor in his success, may not be postponed until many of his best years have been spent in a de-

pressing effort to accomplish the impossible. A young teacher is fortunate if, during this time, he is not obliged to suppress his desire for research, acquired by years of training, in order to avail himself of opportunities to add something to his meager income.

Data concerning the salaraies paid to teachers of science in public schools below college grade are to be found in the Report of the Committee of the National Educational Association on Salaries, Tenure and Pensions of Public School Teachers in the United States, dated July, 1905. From the extensive tables there given it would appear that the average maximum salary paid to male teachers in cities or towns having from 8,000 to 12,000 inhabitants is about $800 per year, in cities numbering 10,000 to 15,000 about $1,000, in those of 15,000 to 30,000 population about $1,200, in cities of 30,000 to 75,000 inhabitants about $1,500, and so on up to cities of 200,000 inhabitants or over, when the maximum is about $2,000. The highest salaries are paid in New York, amounting probably to $3,500 for those having positions of sub-masters or heads of departments. The opinion has been expressed to me by well-informed science teachers that the salaries paid such teachers do not differ essentially from the average salaries named above, but that salaries paid by private schools may be in general somewhat higher than the figures named. Here, again, it seems to me that those in authority should realize that more than a bare living wage must be provided for the younger teachers if the best results are to be obtained, and my own observations lead me to express a further belief that the efficiency of these teachers is much less than it might well be because of inadequate assistance—a condition of affairs which makes it necessary for them to devote time which should be spent in instruction to the mere distribution of supplies. It is expected that these and other related topics will be considered in detail at some early session of the Education Section of the American Chemical Society. I will not, therefore, dwell longer upon them now.

It has already been said that the opportunity for accomplishment which the technical field opens before the young man is alluring to a high degree, and, although I have thought it wise to dwell first upon the financial aspects of a teacher's career, I am far from thinking that the avoidance or abandonment of that career by those who have shown themselves fitted to enter upon it, is mainly due to anything which could be described as greed or avarice. What, indeed, can be better worth undertaking than the development of a new industrial process, very likely the product of one's own careful thought; to watch it grow from a thing of the beaker and test-tube in the laboratory to the successful operating plant, where tons are substituted for grams? Where are there problems better worth attacking than the careful investigation of sources of difficulty in existing processes, with the sense of satisfaction and triumph which accompanies their ultimate rejuvenation? And to whom does there come wider opportunity for honorable service and tangible reward than to one who, through leadership and the helpful guidance of a corps of trained investigators such as are found in the research laboratories of some of our larger manufacturing organizations, has at once the privilege of extending the boundaries of his chosen science and, by improving or cheapening production, to increase industrial efficiency, which in many instances means ultimate benefit for us all. The joy of material accomplishment belongs to the worker in each of these fields.

What is there, then, left to be said in behalf of science teaching as a career? Very much; almost everything indeed, if

we are speaking to the man whose aptitude lies in that field. Let us turn again for a moment to its bug-bear, the financial side, which will then be finally dismissed. Conditions are not just as we, the teachers, or the college authorities, would desire them to be, but there are signs of improvement, which this Association and the Chemical Society can promote. But after all, the teacher's patience is ultimately rewarded by a monetary return which for the really able man (who alone would receive the higher rewards in the commercial field) is not inconsiderable. Moreover, his tenure of office is in general secure during good behavior, and it is no small comfort to feel that the salary check, though of moderate amount, will appear regularly during those times of stress when our supposedly more fortunate brothers are growing grey with anxiety regarding the next turn of the market.

The science teacher of to-day is, moreover, usually something of a specialist and expert, and I believe that it is his duty, as well as his privilege, to make himself acquainted with the applications of his specialized knowledge in the technical field, and so far as it may be done without violence to duties already assumed, to avail himself of opportunities for expert service, especially where these involve an impartial treatment of problems of some importance. Service of this sort well-performed is highly remunerative, and serves at once to broaden the teacher and to contribute to the comfort of those dependent upon him; and in individual instances, to relieve much of the disparity between the income of the teacher and the technicist. In this respect the science teacher possesses a distinct advantage over his brother in the academic field, and the engineer or chemist an advantage over the specialist in a descriptive science, such as astronomy.

The effect of the establishment of the Carnegie Foundation for the Advancement of Teaching must not be overlooked. Its generous endowment provides, as many of you know, retiring pensions which may be claimed as of right by teachers who have served in a professorial capacity for twenty-five years, or who have reached the age of sixty-five, with a record of fifteen years of professorial work. Provision is also made for the family of a teacher who at the time of his death was entitled to a pension. It may, however, be noted that at present no general provision is made for the same class of junior professors referred to above as struggling with meager salaries. It would undoubtedly prove exceedingly helpful, both by relieving anxiety and by making the teaching profession more attractive, if it were ultimately found practicable to provide widows' pensions in the case of the death of junior teachers who have not completed the prescribed twenty-five years of service. It is apparently true, however, that the trustees of the Foundation would even now consider individual cases of need, on their merits.

But what of the opportunities, the privileges of the teacher? They are almost limitless. Is there drudgery? Yes; but what vocation is without it? Does he have to repeat the same story year after year? In part, yes; but it never need be wholly the same and the audience is never twice the same. And the long vacations? They are available, if they are needed (and then they are blessed indeed), but they are seldom periods of continuous idleness, but are rather one of the great opportunities which come to the teacher, as to few others who are under obligations to render definite services. To the progressive, enthusiastic teacher these should be periods of growth; a chance for uninterrupted thought regarding his specialty or his work; a chance

notes and hoped to bring them out in a separate publication.

Giard stayed in Lille until 1887, when he accepted a call to Paris as professor in the École Normale Supérieure, and a year later the municipality created for him a professorship in the Sorbonne for the Évolution des Êtres organisés, which he occupied up to the time of his death.

In 1900 he was elected a member of the Academy of Sciences, and during the last few years several of the most important foreign academies had likewise admitted him to their ranks.

There was scarcely a contemporary naturalist who possessed in similar degree Giard's gift of interesting and attracting younger workers. His manner was cordial, happy, inspiring; his students felt that they could rely upon him, and he in turn guided their steps with the keenest interest, gave them his personal support in their career and rejoiced with them in their success. He was not only a master but a true and wise friend.

His science was eminently altruistic; he worked surrounded by his pupils, happy to see them continue and complete discoveries which he had already outlined. His faculty of observation drew his attention to what might prove interesting in many branches. In almost every group he found material for study, and his works consisted chiefly of short papers, results of personal investigations, full of original and suggestive ideas. Nearly every aspect of biology was touched upon—systematic zoology, anatomy, embryology, etiology, comparative pathology, teratology, applied zoology, botany, zoological philosophy. His papers are dispersed among a multitude of periodicals, and it would be a difficult task to collect them had there not been published the usual complete bibliography and résumé (1896) when he was admitted to the Academy of Sciences.[3]

I will mention only a few of Giard's most important results: such, for example, are his numerous researches on parasitism, during which he discovered many very curious types, *e. g.*, the orthonectida, also an admirable series of papers in collaboration with Jules Bonnier on the epicarides, the isopodous parasites of crustacea. His synthetic genius, combined with minute observation and rare erudition, enabled him to seize and combine ideas and facts which would otherwise seem to have no connection, and he introduced into general biology new and important ideas founded on well-proved experiences. For instance, the action of water and the phenomena of *anhydrobiosis*, the curious modifications produced by parasites on their hosts, *e. g.*, in cases of castration by parasites, and the interesting variations of development of individuals of the same species or closely approaching species which he called appropriately pœcilogony.

Giard was one of the few naturalists who had the gift of being both original and encyclopedic. He possessed in an unusual degree a knowledge of infinite details of nature and of general philosophy, as one can judge indeed from the lecture he delivered at St. Louis in 1904.[4]

His brilliant intellect and prodigious memory enabled him to retain the quantity of material contained in his wide-spread readings, so that he was really a living encyclopedia and always up to date, opening immediately at the page wanted, to be examined at leisure by all who desired to acquire knowledge.

All these qualities remained unobscured to the last day of his life, and his loss is felt as an untimely one to all who came in touch with his many activities.

It is as though a torch carried before the crowd to light the way had been too soon extinguished.

M. CAULLERY
UNIVERSITY OF PARIS

SCIENTIFIC NOTES AND NEWS

DR. DAVID STARR JORDAN, president of Stanford University, has been elected president of the American Association for the Advancement of Science for the meeting to be held

[3] "Exposé des titres et travaux scientifiques (1869–96) d'Alfred Giard," Paris, 1896, in quarto, 396 pp.

[4] "Les tendances actuelles de la morphologie et ses rapports avec les autres sciences."

next year in Boston. The vice-presidents for the sections and newly elected secretaries are as follows:

Section A—Mathematics and Astronomy—Professor Ernest W. Brown, Yale University.

Section B—Physics—Dr. L. A. Bauer, Carnegie Institution, Washington, D. C.

Section C—Chemistry—Professor William McPherson, Ohio State University.

Section D—Mechanical Science and Engineering—Dr. J. F. Hayford, U. S. Coast and Geodetic Survey.

Section E—Geology and Geography—Dr. R. W. Brock, director of the Canadian Geological Survey.

Section F—Zoology—Professor William E. Ritter, University of California.

Section G—Botany—Professor D. P. Penhallow, McGill University.

Section H—Anthropology and Psychology—Dr. William H. Holmes, Bureau of American Ethnology.

Section I—Social and Economic Science—President Carroll D. Wright, Clark College.

Section K—Physiology and Experimental Medicine—Professor Charles S. Minot, Harvard Medical School.

Section L—Education—Professor J. E. Russell, dean of Teachers College, Columbia University.

General Secretary—Professor Dayton C. Miller, Case School of Applied Science.

Secretary of the Council—Dr. F. G. Benedict, director of the Nutrition Laboratory of the Carnegie Institution.

Secretary of Section H—Anthropology—Professor George Grant MacCurdy, Yale University.

Secretary of Section K—Physiology and Experimental Medicine—Dr. George T. Kemp, Champaign, Ill.

THE officers of the American Society of Naturalists elected at the Baltimore meeting are as follows: *President,* Professor T. H. Morgan, of Columbia University; *Vice-president for the Eastern Section,* Professor W. H. Howell, Johns Hopkins University; *additional members of the Council,* Dr. D. T. MacDougall and Professor Charles H. Judd. Professor H. McE. Knower and Dr. Hermann von Schrenck were reelected as secretary and treasurer, respectively.

PRESIDING officers of societies meeting at Baltimore were elected as follows: The Geological Society of America, Mr. G. K. Gilbert, of the U. S. Geological Survey, for the second time, he having held this office in 1892; The American Chemical Society, Dr. W. R. Whitney, director of the Research Laboratories of the General Electric Company, at Schenectady; The American Zoological Society, Professor Herbert E. Jennings, of the Johns Hopkins University; The American Anthropological Association, Dr. W. H. Holmes, chief of the Bureau of American Ethnology; The American Psychological Association, Professor Charles H. Judd, professor of psychology at Yale University and director-elect of the School of Education in the University of Chicago.

PROFESSOR T. C. CHAMBERLIN, after presiding at the Baltimore meeting of the American Association, left for San Francisco on his way to China, where he will study the geology of the country with special reference to its influence on social and educational conditions, as a member of a commission sent by the University of Chicago.

DR. ERNST HAECKEL, professor of zoology in the University of Jena, will retire from active service at the close of the present semester.

AT the commemoration of the centenary of Charles Darwin by the University of Cambridge in June, 1909, the Royal Geographical Society will be represented by its president, Major Leonard Darwin.

PROFESSOR HERMANN VOLZ, the sculptor of the Bunsen monument at Heidelberg, has been given an honorary doctorate by the university.

SIR ARCHIBALD GEIKIE will give an address on the occasion of the celebration of the fiftieth anniversary of the Geological Society of Glasgow to be held on January 28.

DR. NORMAN E. DITMAN, instructor in pathology at Columbia University, has been appointed by President Butler chairman of a committee of twelve to investigate and report at an early date, upon the feasibility of establishing at Columbia a school or department of sanitation.

DR. J. J. KINYOUN has been appointed pathologist and Dr. Truman Abbe, radiologist

on the staff of the Tuberculosis Hospital at Washington.

DR. EDWARD C. HILL has been appointed chemist in charge of the state station of the United States Department of Agriculture recently opened in Denver.

A DINNER was given at Saranac Lake on December 19, at which Dr. Baldwin presented Dr. E. L. Trudeau with two volumes of reprints on the "Studies in Tuberculosis" by his pupils in commemoration of his sixtieth birthday. Dr. Walter V. James presented Dr. Trudeau with letters from personal friends congratulating him on the occasion.

WE learn from the *Journal* of the American Medical Association that the French government has conferred the decoration of the Legion of Honor on Dr. Carlos J. Finlay, of Havana, in appreciation of his discoveries in regard to the transmission of infection by mosquitoes. The presentation of the decoration was celebrated, at the same time as his seventy-fifth birthday, at a special meeting of local and national notables in the assembly hall of the Academy of Sciences, Havana. At the same time a decree of the provisional governor was read setting forth the importance to the Cuban people of the professional services of Dr. Finlay, especially in connection with the discovery of the means of transmitting yellow fever. This decree provides for the retirement of Dr. Finlay at his own request and because of his advanced age, from the position of chief sanitary officer, and for his appointment as honorary president of the National Board of Sanitation and Charities, which office is created for his life time and will terminate with his death. The salary of this position is to be $2,500 per year. The decree also provides for the publication by the government of a volume of selections from the writings of Dr. Finlay, not to exceed 500 pages nor 1,000 copies.

THE Board for Biology and Geology at Cambridge University has adjudged the Walsingham medal for 1908 to C. C. Dobell, B.A., fellow of Trinity College, for his essays entitled "Protista parasitic in frogs and toads," and "Chromidia and the binuclearity hypotheses"; and a second Walsingham medal to G. R. Mines, B.A., Sidney Sussex College, and D. Thoday, B.A., Trinity College. Mr. Mines's essay was entitled, "The spontaneous movements of amphibian muscles in saline solutions"; and Mr. Thoday's essay was entitled, "Increase of dry weight as a measure of assimilation."

PROFESSOR FREDERICK STARR, of the department of anthropology of the University of Chicago, gave, on December 9, a lecture at the Ohio State University on "The Peoples of the Congo Free State." This lecture was the first to be given by the Society of Sigma Xi under the J. C. Campbell Lecture Fund.

GEORGE WASHINGTON HOUGH, professor of astronomy at Northwestern University and director of the Dearborn Observatory, known for his important observations on Jupiter and for measurements of double stars, vice-president of the American Association for the Advancement of Science in 1902, died at Chicago on January 1 at the age of seventy-three years.

DR. J. P. GORDY, professor of the history of education in New York University, and his wife committed suicide on December 31, following the death of their only child. Dr. Gordy was born in Salisbury, Md., 1852, received the doctor's degree at Leipzig in 1884, and was professor at Ohio University and Ohio State University until he came to New York University in 1901. He was the author of works on psychology, American history and the history of education.

DR. RICHARD A. F. PENROSE, formerly professor in the University of Pennsylvania, and eminent as a physician and surgeon, died in Philadelphia on December 26, at the age of eighty-two years.

MR. JOSEPH LOMAS, lecturer in geology in Liverpool University, has been killed by a railway accident in Algeria, where he was carrying on geological investigations.

DR. CHARLES EDWARD BEEVOR, known for his contributions to the knowledge of our nervous system, died in London on December 5 at the age of fifty-four years.

DR. ERNEST HAMY, professor of anthropology in the Natural History Museum, Paris, died on November 18, at the age of sixty-six years.

LORD ROSSE bequeathed £1,000 to Trinity College, Dublin, for the science schools. His telescope and scientific instruments are left to his oldest son, with £2,000 for their upkeep.

A CORRESPONDENT writes to the London *Times* that the Nizam of Haidarabad has established a well-equipped astronomical observatory in his dominions. The foundation of the observatory owes its origin, to the presentation by the late Haidarabad noble, Nawab Zaffer Jung Bahadur, F.R.A.S., of two large telescopes, but it is evident from the equipment of the observatory, from the selection of its director, and from the working program which has been drawn up, that his Highness intends to go far beyond the original intention of the donor, Nawab Zaffer Jung. The equipment includes, besides the purely astronomical and meteorological instruments, a very complete photographic department and extensive workshops fitted with modern tools and appliances for both wood and metal working. The program of the observatory is both comprehensive and ambitious.

BY the President's order the Secretary of the Interior has withdrawn from entry all the public lands, embracing about 6,500 acres in the petroleum and natural gas field in northwestern Louisiana known as the Caddo oil field. This action is taken pending a careful geologic investigation by the U. S. Geological Survey with a view to preventing a waste of natural gas that has been estimated at 75,000,000 cubic feet a day, or more than one twentieth of the amount of this fuel usefully consumed in the United States.

PRESIDENT ROOSEVELT has signed a proclamation setting aside and naming the Ocala National Forest in Marion County, in eastern Florida, the first created east of the Mississippi River, and another proclamation creating the Dakota National Forest in Billings County, North Dakota. The two proclamations add two more states to the list of those wherein land will be put under scientific forest administration. There are now nineteen states, and Alaska, having national forests. Before the creation of the Ocala, in Florida, the two forests in Arkansas, the Ozark and the Arkansas, were the easternmost national forests. Practically all the other national forests are in the Rocky Mountain and the Pacific coast states. The Florida forest has an area of 201,480 acres, of which about one fourth has been taken up under various land laws. It covers a plateau between the St. John's and Ochlawaha rivers and at no point is an elevation exceeding 150 feet above sea level obtained. The area is by nature better fitted for the production of forest growth than for any other purpose. Nearly all of the area, however, seems particularly well adapted to the growth of sand pine which is even now replacing the less valuable species, and with protection from fire almost the entire area will in time undoubtedly be covered with a dense stand of this species. The long-leaf pine, a much more valuable commercial tree than the sand pine, appears rather sparsely in this forest and is confined principally to the lower flat lands along the streams on the borders of the forest. The new Dakota national forest consists of 14,080 acres in the Bad Lands region. Its creation is important, for it means that an experimental field for forest planting has been secured in North Dakota, the least forested state in the union, having only one per cent. of tree growth. The Forest Service expects to establish forest nurseries with the hope that in time to come the area may be reforested by artificial means. This feature is expected to prove a very good object lesson to the settlers, who it is hoped will in turn plant windbreaks around their farms.

THE relation between the increasing use of cement and the diminishing timber supply in the United States has been the subject of some correspondence between the Geological Survey and the Forest Service at Washington. In a letter to the forester, the director of the survey took occasion to quote from a statement of a large Philadelphia firm to the effect that it would be difficult to estimate what the additional drain on the lumber supply would have

been during the last few years had not cement come into such general use. The forester replied in part as follows: "The Forest Service is watching with a great deal of interest the increasing use of cement and other substitutes for wood. They are undoubtedly having some influence on the price of lumber, though I do not think that up to the present time they have greatly retarded the advance in lumber prices. The fact is that our industrial progress has been so great that our requirements for every kind of structural material have increased tremendously. We are using at the present time more lumber per capita than ever before and probably twice as much per capita as we did fifty years ago. The conclusion can not be escaped, therefore, that in the future we must depend more than in the past on other materials than wood for certain purposes at least. As to the increase that will take place in the production of cement, my impression is that this will be very great." If the increase in the use of cement in the United States in past years is to be regarded as any index to its future use, the conclusions of the forester are well founded. The statistics of the production of minerals show that our output of cement has more than doubled in the last five years, and it is well known that its use is being very widely extended. This is due to two conditions: In the first place, excellent cement materials are common in almost all sections of the country; in the second place, reinforced concrete for heavy building material is receiving increased favor among engineers, while in the country regions large amounts of cement are being used for building blocks for smaller structures. Reports received by the survey during the six years from 1902 to 1907 show that the production of cement in the United States has increased from 25,000,000 barrels, valued at approximately $25,000,000, to 51,000,000 barrels, valued at $55,000,000, the annual statistics showing a steady increase in production with some slight fluctuations in price.

THE western phosphate lands recently withdrawn from entry by the Secretary of the Interior in accordance with the President's order comprise portions of Morgan, Rich and Cache counties in Utah; portions of Bear Lake, Bannock, Bingham and Fremont counties in Idaho; and nearly all of Uinta County in Wyoming—in all about 7,500 square miles of land more or less underlain by phosphate rock and constituting the greatest known phosphate deposit of the world. Phosphoric acid is an essential constituent of productive soil. Work at agricultural experiment stations in Wisconsin, Ohio and Illinois has shown that in fifty-four years the cultivated soils of those states have been depleted of one third of their original content of phosphoric acid, or at an annual rate of about 20 pounds per acre. Even if the loss has been only one half this amount it would require 6,000,000 tons of phosphate rock annually to offset this depletion in the 400,000,000 acres of cultivated lands in the United States, without allowance for increase in the area cultivated or in the agricultural yield. The list of lands to be withdrawn was furnished by the United States Geological Survey as a result of preliminary examinations made in the field. Further work will be done by the survey as soon as practicable, for the purpose of making a careful classification of the lands and restoring to agricultural entry such portions as may contain no phosphates. It is pointed out by the survey that the situation of this western field is most favorable. The smelters at Butte and Anaconda give off gases, chiefly sulphurous, which are very injurious to vegetation. These gases can be utilized to great advantage by converting them into sulphuric acid for the manufacture of superphosphate fertilizer, thus transforming a substance that is injurious to vegetation into one that is beneficial.

A LETTER to *Nature* signed "T" reads as follows:

> The council of the Chemical Society, at a recent meeting when it was determined to exclude women from the fellowship, but to admit them to the society as "subscribers," decided, "after mature deliberation"—the phrase is the senior secretary's—that the appellation "subscriber" should be printed with a big S!
>
> Daughters of Eve! So zealous to pursue
> The work in Life by which you seek to live!

When F.C.S. you claim, as is your rightful due—
The S alone is what they, grudging, give!
Be patient! Time is on your side.
Reason and justice will your cause defend.
Ignoble spite and arrogance of pride
Shall meet their retribution in the end!

UNIVERSITY AND EDUCATIONAL NEWS

Mr. George M. Laughlin, of Pittsburg, has bequeathed, in addition to $125,000 to the hospitals of the city, $100,000 to Washington and Jefferson College.

The authorities of University College, Bristol, as part of the scheme to establish a University for the West of England, have purchased the Blind Asylum and its lands, which adjoin University College.

In memory of the late Sir George Livesey, it is proposed to establish a professorship of fuel and gas engineering at Leeds University, for which purpose at least £10,000 will be collected.

Dr. F. W. Eurich has been appointed professor of forensic medicine in the University of Leeds.

Dr. Max Rubner, professor of hygiene at Berlin, will succeed Professor W. Engelmann as professor of physiology.

As successors of Professor Haeckel, at Jena, the faculty has proposed Professor Lang, of Zurich, Professor Kückenthal, of Breslau, or Professor Platte, of Berlin. It is said that Professor Platte will be selected by the administration.

DISCUSSION AND CORRESPONDENCE

LIGHTS ATTRACTING INSECTS

To the Editor of Science: In the issue of Science of December 4, 1908 (N. S., Vol. XXVIII., pp. 797, 798), Mr. Owen Bryant states certain observations and asks certain questions regarding the reaction of insects to lights from different sources. As to the relative efficiency in attracting insects of mercury vapor lights, flaming arc lights using sodium carbons, and ordinary arc lights, *when all are of the same area*, I can give no information, nor am I aware that accurate tests of this nature have been made. In a general way, however, it is probable that Mr. Bryant's view that the light of shorter wave-lengths has more effect is correct, since it has long been known that certain insects, such as ants, give little or no response to red light. This is generally true for the lower organisms, even including *Amœba*.

But Mr. Bryant has made the common mistake of considering only the intensity and quality of the lights and not taking the *area* into consideration. His observations are very similar to those of Loeb,[1] who found that a certain crepuscular moth (*Sphinx euphorbiæ*), when liberated in a room lighted on the one side by a window and on the other by a kerosene lamp, always flew to the window unless it was very close to the lamp when set free. Parker[2] made further experiments on the same phenomenon in *Vanessa*, and I have elsewhere published[3] the results of experiments on several species of insects and a number of other animals, whose reactions were tested to two lights of the same quality and equal intensity, but of different area. The general result was that positively phototropic animals possessing image-forming eyes, such as the butterflies and moths, reacted by going much more often toward the larger light. This would seem to explain the observations of Mr. Bryant in the room, and might possibly apply to some of the kinds of lamps he mentions. At any rate, it shows the necessity of keeping in mind the factor of the *size* of the sources of illumination as well as the intensity and quality of the light they give. In considering size the large globe (as in the case of the arc light) and other parts or adjacent surfaces that reflect light must be taken into account.

Leon J. Cole

[1] Loeb, J., "Der Heliotropismus der Thiere und seine Uebereinstimmung mit dem Heliotropismus der Pflanzen," Würzburg, 1890, p. 47.

[2] Parker, G. H., "The Phototropism of the Mourning-cloak Butterfly, *Vanessa antiopa* Linn.," Mark Anniversary Volume, No. 23, pp. 453–469, pl. 33, 1903.

[3] Cole, L. J., "An Experimental Study of the Image-forming Powers of Various Types of Eyes," *Proc. Amer. Acad. Arts and Sci.*, Vol. 42, No. 16, pp. 333–417, 1907.

EDUCATION AND THE TRADES

To THE EDITOR OF SCIENCE: I was much interested in the letter of Stella V. Kellerman in your issue of November 13, in relation to "Education and the Trades." Her words "Only by teaching honestly what the world needs, and can use, may the schools accomplished their lofty aims" should be taken as a motto by educational leaders and authorities the world over. I should like to ask a question which I hope some day to see answered in SCIENCE:

Suppose a poor man is enabled by close saving to send his son to a high school "to get an education." The boy does not know what he is "going to be," has no ideas of any trade, business or profession, but he wants to be "educated," and is an average student. There may be hidden in this boy a Lincoln, a Carnegie, an Edison or a Rockefeller. He may have it in him to become a book-keeper at $1,000 a year, or a good mechanic at $3 a day. No one knows. By the time he gets through high school he may have acquired the ambition to go to college, or he may be tired of school and want to "go to work" at anything that turns up. *This is the average high school boy.*

What should be the high school curriculum for such a boy? If the elective system is in vogue who shall make the election for him, and on what basis or theory shall it be made, so as *not to waste the time* of the boy while he is in the high school? WM. KENT

THE NEW YORK SERIES

To THE EDITOR OF SCIENCE: In view of the fact that my article on revision of the New York Series[1] is apparently much antedated by Dr. Grabau's paper before the New York Academy,[2] may I ask space to explain that my manuscript, exactly as printed, was submitted for publication the last of December, 1907, one week before Dr. Grabau's paper was read. A comparison of the two papers will reveal the changes necessary in my table to give proper recognition to the names introduced by Dr. Grabau, which thus acquired priority of publication. GEORGE H. CHADWICK

[1] SCIENCE, No. 715, p. 346, September 11, 1908.

[2] SCIENCE, No. 694, p. 622, April 17, 1908.

SCIENTIFIC BOOKS

A Text-book on Roads and Pavements. By FREDERICK P. SPALDING, Professor of Civil Engineering, University of Missouri, Member American Society of Civil Engineers. Third edition, revised and enlarged. New York, John Wiley & Sons. 1908.

This book was first issued in 1894 while Professor Spalding was connected with Cornell University. A second edition was published in 1903. The many changes in methods of construction and maintenance, due in part to new traffic conditions, has made it necessary for the author to practically rewrite several chapters for this the third edition. In this, as in former editions, the author discusses the principles involved in the construction and maintenance of the various kinds of streets and roads. The first chapter, on road economics and management, contains, among other things, some interesting paragraphs on tractive resistance, in which is given a valuable table showing the relative loads a horse can draw on different kinds of roads and on grades from one to fifteen per cent. This chapter also contains articles on the economic value of better roads, sources of revenue and systems of road management. The second chapter deals with drainage of streets and roads and contains a table showing the proportions and dimensions of materials used in building reinforced concrete culverts of different sizes. This table should be of especial value to highway engineers and road builders. The third chapter relates to the location of country roads, and is treated from an engineering as well as from a practical standpoint. Chapter four, on the improvement and maintenance of country roads contains information on the building of earth roads, the use of the split-log drag, best methods of building gravel, oil, sand-clay and burnt-clay roads, and the advantages of wide tires. Broken-stone roads are considered in chapter five, which contains articles on the macadam and Telford methods of construction, rock for road building, methods for testing materials, main-

tenance of roads, bituminous macadam, etc. The theory and practise of foundations for pavements are presented in chapter six. Chapter seven relates to brick pavements, and contains complete information as to the most approved method of testing paving brick, and the construction and maintenance of brick pavements. The use of asphalts and bitumen in paving is discussed fully in chapter eight. The treatment and testing of wood blocks and the construction of streets of this material are treated in chapter nine. Chapter ten presents the most approved method of building pavements of granite and sand-stone blocks. The eleventh and last chapter presents various methods of arranging city streets so as to best accommodate the traffic. This is a practical book, and is advanced in character. On the whole the author covers his subject well. However, the first chapter could have been more complete, especially the portions relating to the economic value of good roads, cost of wagon transportation, and the benefits derived from road improvement. In the paragraphs relating to the testing of road materials, Mr. Spalding draws from what appears to be the latest published information on the subject, and fails to include a number of important improvements which have been made recently by road-material laboratories, notably the Office of Public Roads in Washington, both in testing machines and in the methods of testing road materials. The chapters on brick and bituminous pavements are probably the strongest features of the book.

ALLERTON S. CUSHMAN

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for December has as its first article a paper on "Some Physiological Effects of Radium Rays" by Charles S. Gager, the author concluding that, up to a certain point the effect of radium is to stimulate growth, while beyond that it causes retardation or death. W. A. Cannon discusses "The Origin of Structures in Plants" and Braxton H. Guilbeau the "Origin and Formation of the Froth in Spittle Insects." His conclusion is that this is made up from two sources; the fluid portion being the anal secretion into which air is introduced by the caudal appendages, while the mucilaginous part is secreted by the glands of Batelli. William A. Hilton has a note, with an illustration, of "Peculiar Abnormal Teeth in a Jack Rabbit"; David Starr Jordan furnishes an unusually large number of "Ichthyological Notes," relating to many papers, and H. E. Jordan gives a "Digest of C. Correns's Memoir on the Inheritance of Sex in Higher Plants." The number is accompanied by the index to Vol. XLII.

Bird-Lore for November-December has articles on "The Sea Birds' Fortress (Bird Rocks)," by A. C. Bent; "The Drumming of the Ruffed Grouse," by E. J. Sawyer, with a picture from life; "The Use of a Blind in the Study of Bird Life," by Frank M. Chapman; "A Thrasher Friend," by Emeline Maddock and the seventh paper on "The Migration of Fly-catchers," by W. W. Cooke. The number contains the Report of the Annual Meeting of the National Association (of Audubon Societies) and the Reports of State Societies. This portion of *Bird-Lore* has grown in size and importance and now constitutes one half the number.

BOTANICAL NOTES

NOTES ON RECENT GENERAL PAPERS

PROFESSOR H. M. RICHARD's admirable lecture on "Botany" delivered in the Science, Philosophy and Art course at Columbia University is a concise answer to the questions as to the content and scope of the science of botany. Answering the question that it considers "all the questions as to the form, the functions, the classification and distribution" of plants, the author rapidly sketches the history of the science from Aristotle to Darwin in a few pages, and then discusses the present aspects of the different departments of the subject. Its reading will well repay any botanical student who wishes to be better informed as to the place that botany fills to-day in the world of science.

Here may be noted Mr. B. C. Gruenberg's thoughtful paper on "Some By-products of

Biology Teaching" in the *Proceedings* of the New York Science Teachers' Association for 1907. The writer of these notes would commend it to those young (and old) teachers of biology who think that the subject has value for its content only.

Two little pamphlets for students are Professor Wilcox's "Laboratory Guide to the Study of Elementary Botany," and Professor Clements's "Guide to the Trees and Shrubs of Minnesota." The first is evidently intended for students in such schools as can yet make only rather limited use of the compound microscope and where the laboratory work is necessarily confined to gross anatomy and simple physiological experiments. It must prove useful for the class of students for which it is intended. The second booklet (of twenty-eight pages) succeeds by means of keys and brief descriptions in making it easy for any student of botany to make out the name and relationship of any tree or shrub in the state of Minnesota. Its helpfulness for all classes of botanical students is obvious at a glance.

An instructive and helpful paper for teachers and students of botany is Professor Ramaley's paper on "The Botanical Gardens of Ceylon" in the *Popular Science Monthly* for September, 1908. Eight half-tones from photographs help the readers to obtain a better idea of the rich vegetation of the island.

While not necessarily confined to botany, Mr. O. F. Cook's paper on "Methods and Causes of Evolution"[1] contains so much that bears upon botanical problems that it should be found in every botanist's library. It is a most significant fact that this was published as a contribution to agriculture! What would the farmers just before the civil war have thought if any one had suggested that in half a century they would be practising evolution according to Darwin!

Allied to the foregoing is the same author's paper on the "Reappearance of a Primitive Character in Cotton Hybrids,"[2] giving some individual results of experiments for the purpose of acclimatizing certain weevil-resistant varieties of cotton.

In January, 1905, Captain John Donnell Smith, of Baltimore, presented his herbarium and botanical library to the Smithsonian Institution. The former, consisting of more than 100,000 specimens, became a part of the National Herbarium. Now we have a catalogue of the library of 1,600 bound volumes,[3] which will be very helpful in giving exact titles of many rare books.

CHARLES E. BESSEY

[1] Bull. 136, Bureau of Plant Industry, U. S. Dept. Agric.

[2] Circular 18, Bureau of Plant Industry.

[3] Contrib. U. S. National Herbarium, Vol. XII., Pt. 1.

SPECIAL ARTICLES

NOTE ON SOME NEW JERSEY FISHES

A YOUNG example of *Lactophrys triqueter* was taken at Grassy Sound, on September 18, 1904, and presented to me by Mr. R. M. Miller. This is the first instance of this species occurring in New Jersey waters. Dr. R. J. Phillips obtained an interesting collection at Corson's Inlet, among which were examples of *Anchovia brownii, Hyporhamphus unifasciatus, Trachinotus falcatus, Lagodon rhomboides, Bairdiella chrysura,* young *Micropogon undulatus, Stephanolepis hispidus, Myoxocephalus æneus, Rissola marginata* and *Ammodytes americanus.* The last was very abundant, and many examples of large size were found. An example of *Merluccius bilinearis* was secured at Ocean City, in Great Egg Harbor Bay, on July 26, by Mr. D. McCadden. In this connection I might mention that Mr. O. H. Brown secured an example of the four-toed salamander, *Hemidactylium scutatum,* at Cape May, on July 20, which is the first record of its occurrence in the lower half of the state.

HENRY W. FOWLER

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA,
December 17, 1908

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES

THE academy held its annual meeting Monday evening, December 21, 1908, at the Hotel Endicott,

about seventy-five members and their friends being in attendance.

The report of the recording secretary showed that during the year 1908 the academy had held eight business meetings and twenty-eight sectional meetings, at which ninety-six stated papers and four lectures had been presented, classified under fourteen branches of science; furthermore, that four public lectures by noted home and foreign scientists had been given at the American Museum of Natural History to the members of the academy and the affiliated societies and their friends. Attention was called to the preparations under way for the celebration, on February 12, 1909, of the centenary of the birth of Charles Darwin and the semi-centennial anniversary of the appearance of "The Origin of Species," which promises to be an event of more than ordinary importance to the local scientific public. This report also stated that the membership of the academy was now 458 active members, including 127 fellows and 12 associate active members, a net loss of 42 active members during the year 1908.

According to the report of the corresponding secretary, the academy has lost by death during the past year the following honorary members: Lord Kelvin, elected in 1876; Professor Charles A. Young, elected in 1878; Professor Wolcott Gibbs, elected in 1899; Professor Wm. K. Brooks, elected in 1898; Professor Asaph Hall, elected in 1889; and the following corresponding members: Professor Daniel C. Gilman, elected in 1876; Professor Albert de Lapparent, elected in 1900; Professor Albert B. Prescott, elected in 1876; Colonel Aimé Laussedat, elected in 1890. There are now upon our rolls the names of forty-five honorary and 142 corresponding members. At the meeting three honorary members were elected, namely: Dr. Eduard Strasburger, professor of botany in the University of Bonn; Professor Kakichi Mitsukuri, director, College of Science, Imperial University, Tokyo, Japan; Dr. Wilhelm Ostwald, of the Royal Society of Natural Science, Leipzig, Germany; and the following active members were elected fellows: Dr. Charles P. Berkey and Dr. Charles L. Pollard.

The treasurer's report showed that the financial condition of the academy was satisfactory.

The officers of the academy desire to call the attention of the members to the fact that the academy has in its keeping two important funds, the income of which is available for the encouragement of scientific research. These are the Esther Herrman Building Fund and the John Strong Newberry Fund. Grants are made to members of the academy or of the affiliated societies upon application to the council of the academy with the endorsement by the society of which the applicant is a member. During the past year more than one thousand dollars was paid out from the Esther Herrman Research Fund on account of such applications, and the reports presented by the grantees show the importance of the assistance granted. Income is now available for appropriation upon approved application.

The librarian's report showed that during the past year the library of the academy has received through exchange and donation 454 volumes, 32 separata and 1,863 numbers. The chief accessions were a gift of 40 volumes from La Société des Naturalistes de Varsovie and of 71 volumes from the Sociedad de Geographia, *Lisbon*. The books may be consulted by members and the public any week day between the hours of 9:30 A.M. and 5 P.M., and members are urged to assist in extending the use of the library.

According to the editor's report, part 3 completing volume XVII. was distributed early in the year and parts 1 and 2 of volume XVIII. have been printed and distributed, while two parts of part 3 of volume XVIII. have been printed but not distributed. Part 1 of the latter volume was devoted to the records of the Linnæus celebration of May 23, 1907, including the addresses delivered on the occasion and the greetings received from sister organizations at home and abroad.

The annual election resulted in the choice of the following officers for the year 1909:

President—Charles F. Cox.

Vice-presidents—J. J. Stevenson, Frank M. Chapman, D. W. Hering and Maurice Fishberg.

Recording Secretary—Edmund Otis Hovey.

Corresponding Secretary—Hermon Carey Bumpus.

Treasurer—Emerson McMillin.

Librarian—Ralph W. Tower.

Editor—Edmund Otis Hovey.

Councilors (three years)—Franz Boas, Henry E. Crampton.

Finance Committee—Charles F. Cox, George F. Kunz and Frederic S. Lee.

After the business meeting, the members of the academy and their friends sat down together at the annual dinner, at the conclusion of which the president, Mr. Charles F. Cox, gave an address upon "Charles Darwin and the Mutation Theory."

E. O. Hovey,
Recording Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 15, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE PROBLEM OF SEVERAL BODIES: RECENT PROGRESS IN ITS SOLUTION[1]

I

THE DIFFERENTIAL EQUATIONS AND THEIR TRANSFORMATIONS

WHITTAKER has formulated the classic problem of three bodies as follows: Three bodies attract each other according to the Newtonian law so that between each pair of particles there is an attractive force which is proportional to the product of the masses of the particles and the inverse square of their distances apart: they are free to move in space and are initially supposed to be moving in any given manner; to determine their subsequent motion.

In mathematical phraseology the problem is to integrate a certain system of the eighteenth order of differential equations which at present are usually written in the so-called canonical form

$$dx_i = \frac{\partial F}{\partial p_i} dt, \quad dp_i = -\frac{\partial F}{\partial x_i} dt,$$

in which t is the time, x_i a coordinate, p_i a component of momentum, and F a certain function of all the x_i and p_i.

In recent investigations, especially those originating in the researches of Poincaré, the canonical equations are preferred to other types because of their simplicity of

[1] Abstract of the address of the vice-president and chairman of Section A—Astronomy and Mathematics—American Association for the Advancement of Science, Baltimore, 1908.

form, ease of transformation and perspicuity in showing how the variables enter the problem. It becomes of advantage, then, to expand the function F in terms of canonical elements; Charlier has given in his lectures a method of expansion which Norén and Wallberg carried out to terms of the second degree. Stone has published a simple direct derivation of the canonical elements introduced into the three-body problem by Delaunay and Jacobi; while the formulæ of transformation from Cartesian to Jacobian coordinates in the n-body problem have been derived by Pizzetti with the aid of linear substitutions.

From the standpoint of the theory of integral invariants introduced by Lie and Poincaré the characteristic property of the canonical system is the existence of the relative integral invariant $\int\Sigma x_i dp_i$, and the covariantive correspondence between the canonical system and the differential expression $\Sigma x_i dp_i - F dt$ forms the connection between their theory and that of contact transformations. A systematic study of integral invariants has been published by De Donder, including his own researches and those of Appell, Hadamard and Koenigs. Morera has shown in a series of memoirs how this transformation theory gains in generality, simplicity and elegance when at its foundation we lay the bilinear covariantive correspondence to which allusion has just been made; Morera rediscovers and generalizes the theorems of Lie on the invariance of canonical systems under contact transformations. The importance of these results for the problem in hand is recognized when we recall that Lagrange's method of the variation of arbitrary constants in the theory of perturbations leads to equations of the canonical form; Lie's theory thus stamps the history of a perturbation problem as the history of a contact transformation, a relation exhibited on the geometrical side by the true orbit enveloping the successive approximate ones. The notion of an intermediate orbit has been extended to canonical systems by Charlier, who has employed it in a generalization of Jacobi's theorem.

Lagrange showed that the eighteenth order system in the three-body problem can be reduced to one of the sixth order; this reduction has been effected in a variety of ways by other mathematicians. Poincaré employed a contact transformation to reduce the problem to the twelfth order, and Whittaker has used an extended point transformation to carry the reduction on to the eighth order. Whittaker has also exhibited in explicit form the contact transformations involved in Radau's direct reduction from the eighteenth to the sixth order. Routh's transformation known as the ignoration of coordinates has recently been generalized by Woronetz to a form which includes as special cases Poincaré's equations of motion, and the reductions of Lagrange, Jacobi, Bour and Brioschi. The discovery of the existence of a force center in the three-body problem has enabled Delaunay to write its equations in a special form. Scholz has shown that under certain assumptions regarding the perturbative function the three-body problem can be reduced to the integration of a single differential equation, and a new reduction of the plane problem has been given by Perchot and Ebert. The corresponding reduction of twelve units in the order of the n-body problem has been effected by Bennett through Poincaré's transformation and a generalization of the one employed by Whittaker in the three-body problem.

In the transformation and reduction of the problem a principal rôle has been played by the ten known integrals, namely, the six integrals of motion of the center of gravity, three integrals of angular mo-

mentum, and the integral of energy. The question of further progress in this reduction is vitally related to the non-existence theorems of Bruns, Poincaré and Painlevé. Bruns demonstrated that the n-body problem admits of no algebraical integral other than the ten classic ones, and Poincaré proved the non-existence of any other uniform analytical integral. A strikingly instructive example illustrating these non-existence theorems has been given by Perchot and Ebert. Painlevé has generalized Bruns's theorem by showing that, in addition to the classical integrals of energy and momentum, there exists neither integral nor integral equation algebraic in the velocities, and the theorem of Poincaré, by proving that there exists no new analytical integral uniform with respect to the velocities. Gravé showed that the three-body problem under forces varying as any function of the distance possesses no new integral independent of the law of attraction, and this theorem has been generalized for the n-body problem. Bohlin has very recently added to the non-existence theorems by demonstrating that the mutual distances in the problem of three bodies can not be expressed as the roots of an algebraical equation of the fifth degree with transcendental coefficients.

II

PARTICULAR SOLUTIONS AND THEIR GENERALIZATIONS

In 1772 the prize of the Académie Royale des Sciences de Paris was awarded to Lagrange for an "Essai sur le Problème des Trois Corps." In this celebrated memoir Lagrange "shows that the complete solution of the problem requires only that we know at each instance the sides of the triangle formed by the three bodies; the coordinates of each may then be determined without difficulty. As for the solution of the triangle, it depends upon three differential equations, of which two are of the second order, the third of order three." He determined all the solutions of the problem in which the ratios of the mutual distances of the bodies remain constant. In one of the two distinct configurations the bodies are always at the vertices of an equilateral triangle; in the other they lie always on a straight line. In both of these cases the motion of each body relative to either of the others is the elliptic motion of the two-body problem. Tscherny has constructed these solutions geometrically; he has also shown that the only cases of the three-body problem for which known mathematical and mechanical means suffice are those which reduce to the problem of two bodies. Lagrange's solutions were originally discovered in his problem of the mutual distances; the latter, called by Hesse the reduced problem, has recently assumed a new form under Charlier's treatment, in which the mutual distances are replaced by the distances from the center of gravity. From Lagrange's discussion certain imaginary considerations were omitted; Whittemore has filled this gap, but the completed discussion yields no other real solution. The equilateral triangular solution is possible for all distributions of the masses; their distribution on the straight line is defined by the real positive root of a certain quintic equation; Frederigo has given a new derivation of this equation and Bohlin has formulated four developments, of which three represent the roots of the quintic in three distinct domains, and the fourth for an isolated value. The question of the stability of the solutions furnishes Levi-Civita an example of his theory of stationary motion in which reappear the results of Liouville and Routh, namely, the triangular solution is stable if

$$(m_1 + m_2 + m_3)^2 > 27\,(m_1m_2 + m_2m_3 + m_3m_1),$$

while the rectilinear solution is always unstable.

Theoretical interest in the Lagrangian solutions has been increased by Sundman's theorem that the more nearly all three bodies in the general problem tend to collide simultaneously, the more nearly do they tend to assume one or the other of Lagrange's configurations; and on the other hand practical interest in them has been revived by the discovery of three small planets, 1906 T.G., 1906 V.Y., 1907 X.M., near the equilateral triangular points of the Sun-Jupiter-Asteroid system. Linders has begun the investigation of the motion of the first of these by starting from a periodic solution of the differential equations and developing the Jupiter perturbations from the osculating elements.

Lehmann-Filhés, Hoppe and Dziobek have generalized the exact solutions to cases of more than three bodies placed on a line or at the vertices of a regular polygon or polyhedron, and isosceles triangular solutions have been studied by Fransen, Gorjatschew and Woronetz, while Longley in an investigation of the plane problem of invariable configuration pays special attention to the rhombus. The cases considered by Dziobek and Lehmann-Filhés have been generalized by Pizzetti in a direct study of the homographic motion of n bodies. Among the most interesting extensions of Lagrange's theorem are those due to Banachiewitz and Moulton. The former considers a non-equilateral triangular system with fixed center of gravity and under attractions according to the inverse cube of the distance. He finds a particular solution in which the triangle rotates around the x-axis, its angles remaining constant, and each point describing a curve on a cone of revolution about the same axis which projects into a spiral on the base of the cone. This is the first case of an exact solution in which three finite bodies describe curves of double curvature. Moulton's case is that of the four-body problem consisting of three arbitrary masses, in motion according to either of Lagrange's solutions, and an infinitesimal body; there are eighteen solutions of arbitrary period in which the finite bodies lie on a line, and ten in which they are at the vertices of an equilateral triangle. Periodic solutions analogous to those in the restricted three-body problem have been constructed for Moulton's problem.

The method of Lagrange's memoir has been extended to the four-body problem by Seydler and more recently by Woronetz; the latter has pointed out particular solutions in which three of the bodies are equal; these solutions are given by quadratures if the law of force is inversely as the cube of the distance and are capable of direct extension to the case of any number of bodies.

III

PERIODIC SOLUTIONS AND THEIR APPLICATIONS

The Lagrangian solutions remained the only known periodic solution of the problem of three bodies for one hundred and five years until 1877, when Hill, in his epoch-making researches on the lunar theory, demonstrated the existence of a periodic solution which could serve as the starting point for a study of the moon's orbit. With these memoirs he broke ground for the erection of the new science of dynamical astronomy whose mathematical foundations were laid broad and deep by Poincaré. Up to the time when Hill's work appeared, mathematical astronomers were accustomed to assume a solution of the problem of two bodies as a first approximation in the lunar theory; which intermediate orbit includes none of the inequalities due to the sun's disturbing

force. Hill proposed to take as this first approximation an orbit which would include all the inequalities depending upon the mean motions of the sun and moon. The old theories consisted essentially in suitably varying a solution of the problem of two bodies, while Hill's theory seeks the true orbit by attempting to vary appropriately the restricted problem of three bodies. During the last fifteen years, Brown has published a series of papers, concluding with the 1907 Adams Prize Essay of the University of Cambridge, which extend Hill's work to the construction of the most perfect of all the ten or eleven theories of the moon which have appeared since Newton's "Principia." Hill found periodic solutions of the motion of a particle in a plane under the influence of two bodies which revolve round each other in circular orbits and whose distance apart is infinite. In its initial stages Brown's theory modified Hill's solution in two particulars, first by reducing the distance of the two bodies to finite dimensions, and thus introducing the inequalities which involve the solar parallax, and second by including those inequalities which are due to the moon's eccentricity. Adequate accounts of these theories are given in the presidential addresses delivered on the occasions of the award of the gold medal of the Royal Astronomical Society to Hill in 1887, and to Brown in 1907, while the relations of Brown's perfected work to the highly original pioneer work of Hill are exhibited in the introduction which Poincaré has written to Hill's "Collected Works." Brown has recently finished his complete numerical theory, and lunar tables based upon it are to be published by Yale University. His numerical results furnish an interesting confirmation of the validity of Newton's law. Newcomb proposed an explanation of the motion of Mercury's perihelion by changing the exponent 2 in the Newtonian law to $2 + 0.00000016$. Brown finds in his theory of the moon's motion that the exponent can differ from 2 only by ± 0.00000004.

The work reviewed up to this point in our discussion has found its sources in Hill's periodic solution, the memoir of Lagrange, the non-existence theorems of Bruns and Poincaré, and Lie's theory of contact transformations; that which follows may trace its origins to Poincaré's theoretical and Darwin's numerical investigations on periodic solutions, Newcomb's and Lindstedt's solutions in trigonometric series, Gyldén's theory of absolute orbits, and Painlevé's theorems on the singularities of the problem.

Although periodic and asymptotic solutions do not exist in nature their services to astronomy have been two-fold: to the practical astronomer in supplying first approximations to orbits under investigation, and to the mathematical astronomer in opening the way to further theoretical researches through what Poincaré has characterized as "la seule brèche par où nous puissons essayer de pénétrer dans une place jusqu'ici reputée inabordable." Darwin has constructed a splendid collection of examples of these orbits, planetary and lunar; among his most curious satellite orbits are perhaps those which present three new moons in a month, and another which has five full moons in one period. Darwin's orbits were subjected to a searching analytical examination by Poincaré who showed that two sets of curves which Darwin treated as continuous can not be considered as such; the true sequence of the orbits in question has been exhibited by Hough. Certain of Darwin's results have been derived analytically by Charlier, and specially with reference to the families of oscillating satellites in the vicinity of the five centers of libration corresponding to the exact Lagrangian solutions. In Char-

lier's paper no account was taken of the imaginary centers of libration; the analytical treatment was completed in this particular by a note which showed that there are imaginary centers about which real orbits exist. Plummer has extended Charlier's analysis to arbitrary fields of force, and to terms of the second and third orders in the developments. Schlitt has reckoned five orbits to whose construction Darwin referred as not belonging to the category of simply periodic orbits, and for that reason disregarded by him. With Darwin's orbits Moulton has compared certain of his own, established by Poincaré's method of analytical continuation, and arranged in power series rather than Fourier series. Finally to Darwin's orbits Strömgren has applied his conditions for cusps and loops in the restricted three-body problem; Strömgren has shown that these singularities may be encountered in every point in the plane, in the absolute motion as well as in that referred to moving axes.

Periodic orbits have been variously classified. If the curves are reentrant after a single period Darwin calls the orbits "simply periodic"; all the orbits considered by him have this property. Hill has grouped them broadly into two classes: the first contains those in which a rotation of the whole system has taken place; the second, those in which no such rotation has occurred, but the longitudes of the bodies and their distances have returned to the same values. Poincaré has classified them elaborately into species, classes and kinds, but as Charlier has pointed out this classification is not exhaustive. The great majority of the orbits referred to here belong to the first two kinds, as distinguished by Poincaré, that is, they either have inclination and eccentricity zero or inclination zero and eccentricity not zero. Von Zeipel has published a thorough study of the solutions of the third kind—that is, those having both inclination and eccentricity different from zero—in which they are grouped in no fewer than ten types and their stability discussed by the aid of their characteristic exponents. Whittaker has designed a criterion for the discovery of periodic orbits analogous to those theorems which indicate the positions of the roots of an algebraic equation.

A matter of vital theoretical and practical import in the domain of periodic solutions is the question of their stability. Following Poincaré's lead, Brown has formulated the sufficient conditions for stability in the n-body problem as follows: first, that the bodies never become infinitely distant from one another; second, that their mutual distances never descend below a certain limit; third, that each body passes an infinite number of times as near as we wish to any point through which it has once passed; fourth, that a small external disturbance shall not affect the fulfillment of these conditions. Poincaré stated the first three and investigated the third in detail; numerical limits for the first and second have been found by Haffel in a particular case of the sun-earth-moon system. Levi-Civita has worked out criteria in which the stability is made to depend upon that of a certain point transformation associated with the periodic solution; these criteria show the instability of certain orbits which in the first approximation appear to be stable; they indicate further that contrary to accepted opinion a purely imaginary characteristic exponent α does not always single out a stable solution—the solution is unstable if $\alpha/\sqrt{-1}$ is not commensurable with the mean motion $2\pi/T$. Applying his method to the restricted problem Levi-Civita has found that solutions differing little from circles and having a mean motion $1 + 3/h$ are certainly unstable, thus

proving the existence of zones of instability surrounding Jupiter's orbit which may extend throughout the plane. The above conditions are approximately satisfied for the small planets (167) Urda, (243) Ida, and (396) whose mean motion is near 1 + 3/2 and whose eccentricities and inclinations are very small; the planet (188) Menippo has a mean motion near 5/2, but an inclination and an eccentricity too large for these considerations to be immediately applicable. Kobb has called the attention of astronomers to the fact that he found the orbit of (153) Hilda to be stable but that the conditions for stability are not satisfied by the motion of (279) Thule; the same writer has shown the motion of the seventh satellite of Jupiter to be stable and that of the eighth unstable, while Moulton has established limits of temporary stability for satellite motion. Levi-Civita's criteria have been studied by Cigala, and those of Lehmann-Filhés for circular motion have been generalized by Frank. Gray has given a résumé of the work of Charlier, Hill, Picart, Roche and Schiaparelli on the stability of a swarm of meteorites and of a planet and satellite, and Routh has discussed the motion and stability of a swarm of particles whose center of gravity describes an elliptic orbit of small eccentricity about the sun. Considering a system composed of a planet, a rigid ring, and a satellite Bohl has proved that under certain initial conditions the motion can be terminated only by a ring planet collision; further, that the possibility of the latter collision may be excluded and permanent stability secured.

The new methods in celestial mechanics have proved their usefulness in computing the perturbations of those small planets whose period of revolution is approximately commensurable with that of Jupiter. To enumerate: Simonin has applied Poincaré's methods to the case of Hecuba and has succeeded in obtaining a very close solution by means of simple expressions; Hill has devoted two memoirs to examples of periodic solution in studies primarily concerned with cases of mean motions respectively triple and double (Hecuba type) that of Jupiter; Poincaré has shown the essential agreement between his own results and those of Brendel's "Theorie der kleinen Planeten" constructed along the lines of Gyldén's method; Hill and Andoyer have applied Delaunay's method to the Hecuba group; Poincaré has exhibited the relations of Simonin's results to the applications of Gyldén's method made by Ludendorff to Hecuba, by Brendel to Hestia, and by Harzer to Hecuba; Schwarzschild has made a numerical investigation of periodic solutions in the vicinity of the Hecuba orbit; Wilkens has applied his asymmetric solutions to orbits of the Hecuba type, establishing their stability by Poincaré's method; and finally Wilkens and De Sitter have studied solutions of the Hestia type. A class of periodic solutions was designed by Moulton, and successfully applied to the lunar theory; independently Gyldén and Moulton utilized periodic orbits to explain the Gegenschein; and McCallie, following a suggestion of Hill's, constructed an example of periodic solutions from the theory of Jupiter and Saturn. Strömgren found that asymptotic motion towards one of the equilateral triangular centers of libration takes place only under exceptional circumstances, for as a rule the body describes a periodic orbit around this center or recedes indefinitely from it.

In an exhaustive treatment including all the limitation and libration motions of the special case of the three-body problem when two of the bodies are fixed Charlier has noted two applications: first to the case where a small body passes at great speed through a double star system, and second

to the generalization of those conditions which result in the moon revolving about the sun if the earth and sun become fixed centers. Charlier has also considered the relations of the two-body problem to the two-center problem, and has pointed out the advantages of solutions of the latter as intermediate orbits in the asteroid problem. The case where one fixed center attracts and the other repels was worked out in detail by Wöller; and Hiltebeitel applied the method of Charlier's work to the qualitative discussion of the most general two-center problem admitting of separation of the variables.

Hill has prepared a number of examples of Gyldén's periplegmatic orbits, some of which are periodic. The construction of the solutions calls for elliptic functions, Lindstedt's series, and sequences of Delaunay transformations. These examples of Hill have been generalized in several directions, in one of which certain of Painlevé's new transcendental functions find application. For the case of two nearly equal bodies and a third infinitesimal body Pavannini found a new category of periodic solutions which have been extended to the restricted problem of four bodies. Andoyer's memoir on the relative equilibrium of n bodies has been made by him the basis of a study of periodic solutions in the vicinity of positions of relative equilibrium under forces varying as the masses and any power of the distances. Longley has constructed the only orbits (one direct the other retrograde) of preassigned period in the plane n-body problem which consist of an infinitesimal body revolving around one of $n-1$ finite masses which are in periodic motion. For the plane n-body problem having the same distribution of masses as the solar system, Griffin found a class of periodic solutions of which he has made numerical application to the three inner satellites of Jupiter.

FORMAL AND QUALITATIVE RESOLUTION OF THE PROBLEM

By generalizing somewhat the theory of periodic and asymptotic solutions by which Poincaré established the divergence of Lindstedt's series von Zeipel has been able to study the series, however great the mutual inclination of the orbits may be. He derived the following necessary and sufficient conditions for the existence of the series: first, that the orbits be nearly circular; second, that a certain biquadratic equation have real and unequal roots. Von Zeipel found that if the inclination of an asteroid exceeds a certain limit (about 30°, slightly variable) the series of Lindstedt cease to exist; and he remarked that it is perhaps permissible to see in this theorem, although Lindstedt's series are only semi-convergent, the cause of the surprising fact that among five hundred asteroids there exists but one (Pallas) whose inclination exceeds 30°.

Hill has extended Delaunay's method to the general problem of planetary motion, and, employing the fundamental conceptions of Gyldén, he has indicated a practicable way for its application, in two memoirs on integrals of planetary motion, suitable for an indefinite length of time. Charlier has discussed the properties of the general solution in trigonometric series by supposing it to have been derived from the integration of the Hamilton-Jacobi equation. For constructing solutions in the form of trigonometric series, Whittaker has devised a method, closely analogous to Delaunay's, and consisting essentially in the repeated application of contact transformations which ultimately reduce the problem to the equilibrium problem. Bohlin has just published the concluding memoirs of a remarkable series of investigations which have culminated in a non-existence theorem quoted in a previous paragraph, and in his new astronomical series for the distances

and coordinates; these series, both in their terms and in their coefficients, are built up from certain developments which Bohlin has derived for roots of the fundamental quintic met with in Lagrange's problem of the mutual distances.

The question of the validity of certain methods of Gyldén has been the source of considerable discussion among mathematical astronomers during the period under review. The appearance of a long memoir by Buchholz on Gyldén's horistic method, and its convergence, brought forth from Backlund a protest against the manner in which the material of the memoir had been accumulated and presented. To this protest Buchholz replied with a defense of the course he had pursued in preparing the work; and a little later he published another note objecting to a statement by Schwarzschild that Poincaré, in his prize memoir, had proved the divergency of the series employed by astronomers. About this time Poincaré examined in detail the second of Gyldén's two horistic methods, the first being open to grave objections as had been shown by himself and Backlund. As a result of his investigation Poincaré found that the second method, conveniently modified, is a legitimate one, not for the search of the general solution, but for the determination of one of those particular solutions which he himself had termed periodic. He pronounced futile the effort to derive from the horistic method developments uniformly convergent in the geometric sense of the word, and declared false Gyldén's conclusion that the terms of high order in the perturbative function can never produce libration. Poincaré's results were questioned by Backlund and an interesting controversy ensued, some points of which were elaborated upon in a later extensive memoir which Poincaré devoted to Gyldén's theory, where he pointed out Gyldén's great service to science in creating a number of new methods which have been applied with success to certain problems of mathematical astronomy, as for instance, in the theory of the small planets developed by Harzer and Brendel. He found the methods proposed in Gyldén's earlier memoirs to be correct in the main, but possessed of little more than historic interest, having been superseded by less inconvenient methods such as those of Hill and Brown. Gyldén's later theories Poincaré subjected page by page to a searching critical examination which resulted in a declaration that they are invalidated throughout by errors arising in the initial stages of Gyldén's analysis.

Thanks to the recent researches of Levi-Civita, Bisconcini, Sundman and Block, inspired as they were by an earlier theorem of Painlevé the qualitative solution has been attained in the field of the formal resolution of the mathematical problem of three bodies, and some progress has been made towards the same end in the astronomical problem. Painlevé demonstrated that starting from given initial conditions singularities occur only if one at least of the mutual distances tends towards zero, when t converges to a finite value t_1. When these singularities have been located, the recent theorems of Mittag-Leffler, on the representation of monogenic branches of analytical functions, warrant the assertion that the coordinates are expressible in every case, and throughout the duration of the motion, in series possessing the fundamental properties of Taylor's series. It may be remarked in passing that Volterra has given examples of the applicability of Mittag-Leffler's developments to certain cases of the general n-body problem. From the standpoint of the qualitative resolution of the problem, it becomes of paramount importance, then, to define with precision the initial conditions which lead to a collision. Painlevé in his Stockholm

lectures announced the opinion that the initial conditions which constrain a collision of at least two of the three bodies at the end of a finite time, satisfy two distinct analytical relations, which reduce to one in the case of plane motion. These analytical relations whose existence Painlevé divined have been disclosed by the brilliant researches of the two Italian mathematicians, Levi-Civita and Bisconcini. Levi-Civita blazed the trail in the restricted problem and found an unique, invariant relation, algebraical in the velocities, periodic and uniform, which he developed in a power series. It may be noted that simple modifications of Levi-Civita's analysis render it immediately applicable to the restricted problem of four bodies. There appears again a single uniform periodic condition for collisions of two of the bodies, and this condition is algebraic in the velocities. The result thus constitutes an exception to Painlevé's theorem that when three of the masses are different from zero the conditions which must be satisfied in the n-body problem in order that after a finite interval of time two of the bodies may collide, can not be *algebraical conditions*. In the general three-body problem Bisconcini, following the route marked out by Levi-Civita in the restricted problem, has arrived at two distinct relations whose analytical form he has determined. Bisconcini has thus been able to characterize all the singular motions of the system in which any two of the bodies collide, and to determine the analytical conditions under which we may be certain that the motion will proceed regularly. One of the assumptions made by Bisconcini in the course of this work has since been demonstrated by Sundman. In a new elaboration of his original memoir Levi-Civita has been able to extend certain of his results to the astronomical, restricted problem. Sundman has found the condition for the simultaneous collision of all three bodies to consist in a vanishing of all three integrals of areas in the motion of the bodies with respect to their common center of gravity; if the constants of areas are not all zero, Sundman has assigned a positive limit below which, of the three distances, the greatest always remains so. The same writer has announced the extension of his results to the n-body problem, including explicit expressions for the coordinates in the vicinity of equilibrium. In the meantime Block has presented to the Swedish Academy of Sciences a memoir in which he has given the developments in powers of the time in Sundman's case of collision; these power series contain terms of three different forms in whose exponents the masses of the bodies appear. The recent memoirs of von Zeipel on intransitive motion in the three-body problem and the indeterminate singularities in the case of n bodies are treated in the report reviewed here. Mittag-Leffler is preparing a memoir soon to be published in the *Acta Mathematica* in which there will appear a digest of Weierstrass's correspondence in its bearing on the problem of three bodies. The memoir will be concerned especially with the relations of this correspondence to the setting of the problem for the prize, offered by the late King Oscar II., of Sweden; to the report on which the award of the prize was based; and to the recent work on the singular trajectories of the general problem of three bodies, and its resolution in power series.

V

GENERALIZATIONS OF THE PROBLEM AND ITS INVERSION

During the period under discussion the problem has been variously generalized. Ebert has formulated an equivalent problem to that of n bodies, with an additional integral; and a similar generalization has been made by extending the Bour-Bertrand

treatment of the three-body problem. Esclagnon and Bohl have indicated applications of quasi-periodic functions to the ordinary problem; special cases in which the masses vary with the time have been considered by Mestchersky; Laves has studied the integrals when the forces depend upon the coordinates and their derivatives of the first two orders; and Ebert has taken up the problem in space of any number of dimensions.

Bertrand inverted the problem of two bodies by proposing to find the law of force under which a body, whatever may be its initial position and velocity, always describes a conic section. This inverse problem was solved independently by Bertrand, Darboux and Halphén; and extended by Dainelli to general curve trajectories. Stephanos has recently given another generalization of Bertrand's problem by including in the discussion the case in which the force has not necessarily an unique direction at every point of the conic section. This problem in turn has been generalized to conditions which include the conic section trajectories as special cases. Griffin observed that the law of force under which a given curve is described as a central orbit can not be determined uniquely if only the position of the center of force be known. Oppenheim gave to Bertrand's problem a new treatment which included the case of finding the central conservative forces under which three bodies of arbitrary mass describe given plane curves.

A further generalization of Bertrand's problem presents itself in the problem of finding the forces of a central conservative system capable of maintaining a system of m particles on as many prescribed but arbitrary orbits in a space of n dimensions. The resolution of this problem shows that the central conservative character of the motion and the equations of the orbits are necessary and sufficient to determine the components of the velocities, only in the case of $\frac{1}{2}n(n+1)$ bodies, and the components of the forces only in that of $2n-1$ bodies. From this point of view the plane three-body problem possesses an unique generality of its own, in that it is the only case in which all the elements of the mechanics of the problem are completely determinate when the arbitrary plane curves described by the bodies under central conservative forces are given. This circumstance has been turned to account in the construction of new integrable problems of three bodies under laws of force involving only the masses and the mutual distances of the bodies.

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THE PHYLETIC IDEA IN TAXONOMY[1]

TO-DAY every botanist is an evolutionist. It may well be that we have not yet agreed as to the details—as to the particular manner in which modifications were effected—whether they were by slow and almost imperceptible deviations from the parental type, or those more marked variations that we are in the habit to-day of calling "mutants." Some of us may lay more stress upon the "survival of the fittest," others upon the "survival of the unlike." For some the "struggle for existence" may account for the diversity of plant forms, while others see in "adaptation" the explanation of the same diversity. To some the "inherent tendency" in plants to vary is a potent factor, while for others all variation is a result of "environment." Yet with all this diversity of opinion as to details there is a practical unanimity as to the acceptance of the general doctrine of evolution. It may be asserted without fear

[1] Address of the vice-president and chairman of Section G—Botany—of the American Association for the Advancement of Science, Baltimore, 1908.

of contradiction that all scientific botanists hold that the vegetable kingdom as we know it to-day is the result of a series of evolutions from lower to higher types of plants, and that every higher plant owes its present structure to the favorable modification of some ancestral lower plant. To-day when we study the particular structure of any plant we consider it to be the result of the modifications that have taken place in its phylogenetic history. No botanist now considers a species to be a separate or special creation, but rather a more or less distinguishable variation from some other form.

With such an agreement among botanists as to the validity of the doctrine of evolution, it needs no argument to sustain the thesis that a natural classification must be an expression of a theory of evolution. Such taxonomic terms as "higher," "lower," "primitive," "derived," "relationship," "affinity," etc., can have no other significance than that given them by the doctrine of evolution. To-day there are no hidden or occult meanings to be attached to plant structures. We no longer credit the doctrine of signatures, whether in medical or systematic botany. We no longer seek to find the characters which in some mysterious way are the special marks of classes, nor those which are necessarily ordinal marks, or the characteristic marks of families, and so on to genera and species. And yet it is not so very long since a great biologist seriously set about trying to do this very thing. You will remember that Agassiz made this attempt[2] about fifty years ago, and that he actually formulated his plan in definite terms. I may as well quote the paragraphs in which he states his method of characterizing different groups. They are as follows:

Branches or *types* are characterized by the plan of their structures;
Classes, by the manner in which that plan is executed, as far as ways and means are concerned;
Orders, by the degrees of complication of that structure;
Families, by their form, as far as determined by structure;
Genera, by the details of the execution in special parts; and
Species, by the relations of individuals to one another and to the world in which they live, as well as by the proportions of their parts, their ornamentation, etc.

With regard to these he says a little later[3] that "the branches, the classes, the orders, the families, the genera, the species, are groups established in nature respectively upon different categories," and declares that he feels "prepared to trace the natural limits of these groups by the characteristic features upon which they are founded," that is, upon those which have just been enumerated in my quotation.

In the common systematic characters as drawn up by many botanists in the recent past there has been something of the old-time notion that we are dealing with fixed groups whose limits are indicated to us by certain rather definite structural characters which nature has accommodatingly attached to all plants in these groups. The thought seems to have been that plants are "tagged" or "branded" with the peculiar marks of the group, these marks having otherwise no particular significance. One is reminded of the similar use which stockmen on the plains make of arbitrary names, monograms or hieroglyphics for indicating what animals belong to this or that particular ranch. And it appears that this view of the meaning of taxonomy and the significance of characters has not wholly died out. The most reasonable explanation of the inordinate species making practised by some botanists is that they are still under

[2] "An Essay on Classification," by Louis Agassiz, London. The preface dated December, 1858, p 261.

[3] "An Essay on Classification," p. 263.

the dominance of the old doctrine of the fixity and inviolability of characters, especially the characters of species. When one holds this view it is very easy for him to find in every variation the indication of a new species, for all one must do is to find that every varietal character is really specific according to such rules as those laid down above by Agassiz. One may logically hold that if characters of a particular kind are of "specific" value, they must be valid, however faint or obscure they may be. Probably the recently observed activity in the making of new species is the flickering of the dying flame of this expiring theory. Wholly inconsistent with the doctrine of evolution, it must soon die out, and we may well be patient while it lasts, praying in the meantime that its final happy extinction may not be long delayed.

I need scarcely refer here to the "map theory" of relationship which was once quite the vogue, and of which remnants are still to be seen in some charts showing the relationships of groups. In some of these we still see an attempt to indicate the genetic relationship of a particular group in more than two directions! Before the general acceptance of the doctrine of evolution such an indication of relationship was quite consistent, for into taxonomy no definite conception of genetic relationship had yet entered. Groups of plants were thought of as related to one another, as we think of the relationship of one state to another on a map. And no doubt it was a helpful device for giving clearer notions of the similarities between plant groups. Just as the children in the schools learned much by the exercise of "bounding" the states, so it was profitable in those ante-evolutionary days to use these imaginary maps to show similarities by nearness or juxtaposition. Yet while the practise may once have been profitable, it is no longer so, and to engraft genetic ideas upon it is really quite impossible.

There is still another conception of plant taxonomy to which I must advert, namely, the philosophical division of the vegetable kingdom into convenient groups of various grades, as divisions, subdivisions, classes, subclasses, orders, suborders, etc. Such groups are in a sense natural, in that they are usually characterized by structures which are conceived to have been evolved from others somewhat like them. Yet these have failed to commend themselves permanently, no doubt because generally they have been based upon only one or at best a few closely related characters. Thus the somewhat recent attempt to divide the vegetable kingdom into Protophytes and Metaphytes is an apt illustration, as is also its earlier division into Phanerogams and Cryptogams. And of like nature was the suggestion to divide the dicotyledonous plants into Chalazogamae and Porogamae. The proposal made by Sachs to divide the Thallophytes into Zygosporeae, Oosporeae and Carposporeae, while no doubt it did much to dispel the confusion with regard to the plants included, failed to commend itself generally because it separated clearly related groups of plants. The failure of this arrangement was due not so much to the fact that it was based upon one character—namely, the mode of sexual reproduction—as to the far more important fact that it took practically no account of the evolution of the plants constituting the groups. Herein was its weakness, and in spite of the advantage of clearness and ease of understanding which it possessed to a marked degree, it was never adopted by systematic botanists.

A few columns back I said that a natural classification must be an expression of a theory of evolution. I will go farther now and say that it is sound scientific practise

to change our classification when we change our theory of evolution. This follows logically as a corollary of the main thesis, but it is well to place our acceptance of it on record, lest in our zeal for consistency we may neglect it. No system of classification should stand in its entirety after the theory of evolution upon which it is based has experienced any change whatever. The two must be modified simultaneously, for they are parts of a common system.

What does the theory of evolution involve to-day? It will be well to pause here for a short enumeration of the principal features of this theory so far as they bear upon the question of classification. I need scarcely remind you that for the purposes of this discussion it is not necessary to decide between the different schools of evolutionists, since their differences are almost wholly of such nature as to have little or no bearing upon a system of plant taxonomy.

Elsewhere[4] I have enumerated the following dicta as involved in the theory of evolution as applied to the vegetable kingdom:

1. In general the lower plants came into existence first.

2. In general the higher plants sprang from the lower.

3. Higher plants are more complex than the lower.

4. Structures with many similar parts (homogeneous) are lower, those with fewer and dissimilar parts (heterogeneous) are higher.

5. Evolution is not always upward, but often involves degradation and degeneration.

6. Evolution does not necessarily involve all organs of the plant equally in any particular period.

7. One organ of a plant may be advancing while another is retrograding.

8. Upward development is sometimes through an increase in complexity, and sometimes by a simplification of an organ or a set of organs.

9. In some cases particular structures become more simple while the plants themselves become more complex.

10. Evolution has generally been consistent, and when a particular progression or retrogression has set in it is persisted in to the end of the phylum.

11. Retrogression, once set in, usually persists, and is not followed by a progression.

12. Hysterophytic degeneration is persistent, and the hysterophytic phylum never becomes holophytic.

13. In the first stages in the development of any organ, whether upward or downward, the new structures are not as fixed as they become later, and in these earlier conditions there may be reversions to the ancestral structures, while later such reversions do not occur.

14. All plant relationships are genetic.

15. Plants are related *up and down* the genetic lines, and the system of plants to be quite natural must recognize these phyla.

While these fifteen dicta are by no means all that might be cited, they will suffice for my present purpose. From them the phyletic idea in taxonomy follows logically. Since all natural groups must be phyletic, only that arrangement is natural that recognizes these in their entirety. It should no longer be permissible on scientific grounds to propose a classification which is not phyletic.

We may now profitably inquire as to the origin of phyla, and to seek an answer as far as it is possible to find one in general terms and on theoretic grounds. Stated philosophically, from what we know of the relationship of organic beings it is obvious that a phylum originates with the incoming of a new idea. Stated structurally, it has its beginning with the development of a dominant morphological peculiarity. Stated taxonomically, its initial point is indicated by the appearance of a new character.

Every phylum is the result of a development which differs from that which preceded it because of the incoming of a new dominant idea. This dominant idea was manifested structually by a divergence

[4] "A Synopsis of Plant Phyla," *University of Nebraska Studies*, October, 1907, p. 1.

from the previous lines of evolution, and this point of divergence is the actual origin of the new phylum. As far as this idea dominates, so far does the phylum extend, and when a still newer idea comes in and attains dominance, a still newer phylum has its beginning.

In this manner may we mark the beginning and the extent of phyla. They originate with a divergence which is the expression of a new idea. It is what we often call a "tendency." In taxonomy we refer to it as a "new character," this latter term being sometimes somewhat confusingly applied to the underlying idea and sometimes to its obvious structural expression.

The result of the successive development of phyla is quite like that in a tree where newer branches spring from older ones by the formation of buds, from which branches develop in succession. And as there are branches of all grades, from the primitive diverging growths which eventually divide the tree profoundly into great segments, through the smaller and smaller branches to the very recent slender twigs—the growths of but yesterday—so it is with the development of successive phyla from one another, the result being a complex tree-like aggregation with older phyla below and younger and smaller phyla above.

In order to discern phyla, the botanist must certainly be familiar with the whole vegetable kingdom, or at the least with the great region in which the particular phyla under consideration occur. He must be able to bring to mind the families, genera and species of plants with such clearness as will enable him to see the direction of the evolutionary current—the "drift" of evolution in the vegetable kingdom as a whole, and in the particular portion immediately under his consideration. I know that this is often a difficult task, just as it may be very difficult to determine the direction of the water current in a lake by observations at one point only: yet it may be very easy when the points of observation are multiplied. So it is here difficult, and perhaps impossible, for the man whose point of view is limited to a small portion of the botanical shore-line. The trained eye of the experienced man can catch the drift of the waters from a few properly selected points of observation, and likewise the trained eye of the botanist from observations at properly selected stations may detect the direction of evolutionary progress, as well as the origin and extent of the resulting phyla.

Applying what has been suggested in the foregoing brief and somewhat desultory discussion, it appears to me that we may recognize the following plant phyla of primary rank:

1. *Myxophyceae,* in which the dominant idea is the simple nucleus, typically not limited by a nuclear membrane. The simple plant body, of one or only a few cells, the blue-green diffused pigment, and the soft and often gelatinous walls may be regarded as characters of secondary importance.

Here are included also many hysterophytes (bacteria) which I regard as degenerates from the normal plants of this phylum.

Probably from the highest *Myxophyceae* came the second phylum—

2. *Protophyceae,* in which the dominant idea is the definite nucleus, limited by a nuclear membrane. The simple plant body of one cell or of a repetition of mostly similar cells, the typically motile, ciliated gametes, the definite chromatophores carrying a chlorophyll-green pigment, and the usually firm cell wall, are limiting secondary characters.

I here include *Pleurococcaceae, Ulvaceae, Ulotrichaceae, Oedogoniaceae, Coleochae-*

taceae, and a dozen or so related families. This phylum has been unusually productive of other phyla of primary and secondary rank, and elsewhere[6] I have hazarded the suggestion that from the lower *Protophyceae* (near *Protococcoideae*) a phyletic line passed off and gave rise to the animal kingdom.

Springing from the filamentous *Protophyceae* is the third phylum—

3. *Zygophyceae,* in which the sluggish cells easily separate, and the non-ciliated gametes move feebly. This is a phylum on the down-grade, and all of its members show structural degeneration. In the desmids and diatoms the filaments usually separate early into single cells, resulting in the so-called "unicellular" structure of these plants.

The filamentous pondscums (*Spirogyraceae, Zygnemataceae* and *Mesocarpaceae*) are here held to have given rise by early fragmentation to several secondary phyla, including the three families of desmids, and the many families of diatoms.

From the filamentous *Protophyceae* there came also the fourth phylum—

4. *Siphonophyceae,* in which the dominant idea is the development of coenocytes. The retention of the typically motile ciliated gametes producing simple zygotes upon uniting, the chlorophyll-green chromatophores, and the mostly filamentous or upright plant body which is rooted below, are important secondary characters.

Beginning with the segmented *Cladophoraceae* two secondary phyla may be recognized—one (*Vaucherioideae*) of filamentous plants—the other (*Bryopsidoideae*) of upright and branched plants. Many species have degenerated into hysterophytes.

Again, from the filamentous *Protophyceae* came the fifth phylum—

5. *Phaeophyceae,* in which the dominant feature is the addition of the brown pigment (phycophaein) to the chlorophyll of the cells. The typically motile, ciliated gametes, producing simple zygotes upon uniting, and the filamentous to massive plant body, rooted below, are secondary limiting characters.

Starting with the filamentous and often small *Ectocarpaceae,* this group readily divides itself into two well-marked secondary phyla—*Phaeosporeae,* and *Cyclosporeae,* the former culminating in the gigantic *Laminariaceae,* and the latter in the highly developed *Sargassaceae.*

Going back again to the fertile group of the filamentous *Protophyceae,* we find the origin of the sixth phylum—

6. *Carpophyceae,* whose dominant characters are the reddish pigment (phycoerythrin) added to the chlorophyll of the cells, and the growth of the zygote into a spore-fruit. The mostly erect, symmetrically branched and basally-rooted plant body, and the definite attainment of heterogamy, afford important secondary characters.

Here the typically marine *Bangioideae* and *Florideae* dominate the phylum, and these develop phycoerythrin in their cells, while the green fresh-water *Charoideae* constitute a small side line.

From the more primitive, probably filamentous *Carpophyceae* came the seventh phylum—

7. *Carpomyceteae,* whose dominant idea is the abandonment of the holophytic habit, and the adoption of the hysterophytic habit, with the disappearance of chlorophyll, resulting in the atrophy of the vegetative portions of the plant body and the increase in reproductive structures.

[6] "The Structure and Classification of the Lower Green Algæ," in *Trans. Am. Mic. Society,* Vol. XXVI., 1905, pp. 121–136; and later in "A Synopsis of Plant Phyla," 1907. See also my "Essentials of Botany," sixth edition, 1896, pp. 137–8.

The spore-fruit inherited from the preceding phylum undergoes many changes and is often degenerated, and this sometimes involves the gametes themselves.

This phylum is one of marked departure from the general upgrade evolution in the vegetable kingdom, and its successive smaller phyla show increasing degeneration in the structure of the plant body, which in the rusts and smuts becomes excessive, while in some cup-fungi (*Pezizales* and *Helvellales*), puff-balls (*Lycoperdales*) and toadstools (*Hymenomycetales*) the spore fruit is relatively very large.

From the higher *Protophyceae* (probably near Coleochaetales) came the eighth phylum—

8. *Bryophyta,* in which the dominant idea is the growth of the zygote into an alternate, short-lived generation, the sporophyte, and the consequent adoption of the land habit.

The two secondary phyla are *Hepaticae* and *Musci.*

From the lower *Bryophyta* (probably near *Anthocerotales*) came the ninth phylum—

9. *Pteridophyta,* whose dominant character is the growth of massive roots and broad leaves upon the sporophyte, rendering it long-lived and independent, and resulting in the postponement of spore formation.

It must be noted here that I use the term *Pteridophyta* in the narrower sense, limiting it to ferns (*Filicinae*) and excluding lycopods and horsetails. The incoming of heterospory in some ferns is a significant fact.

From the lower *Pteridophyta* (probably near *Ophioglossales*) came the tenth phylum—

10. *Lepidophyta,* in which the dominant character is the long-lived, erect cylindrical stem of the sporophyte, which bears massive roots below, is covered with many small scattered leaves, and terminates in a strobilus of imbricated sporophylls above.

From the lower *Pteridophyta* again (probably near *Ophioglossales*) came the eleventh phylum—

11. *Calamophyta,* in which the dominant character is the long-lived, erect, cylindrical stem of the sporophyte, which bears massive roots below, regularly whorled leaves and branches, and terminates in a strobilus of whorled sporophylls.

In the two preceding phyla, heterospory, although present, has not yet become fixed. In both the increased definiteness of the strobilus is significant.

From other lower *Pteridophyta* (near *Marattiales* of *Isoetales*) came the twelfth phylum—

12. *Cycadophyta,* in which the dominant idea is the uniform production of heterospores in simple strobili of open sporophylls, upon the megaphyllous, spongy-wooded sporophyte, and the permanent retention of the megaspore in the sporangium, thus forming the seed.

I here include not only the cycads proper (*Cycadineae*), but also the much more primitive "seed ferns" (*Cycadofilices*), the ancestral conifers (*Cordaitineae*), the ancestral flowering plants (*Bennettitineae*), and the maiden-hair trees (*Ginkgoineae*).

From *Cycadophyta* came the—

13. *Gnetales,* if indeed they are not to be regarded as belonging to that phylum.

The three genera are doubtless the surviving remnants of former rather well developed secondary phyla, now nearly extinct.[6]

From the *Cycadophyta* came the fourteenth phylum—

14. *Strobilophyta,* in which the dominant idea is the development of definite,

[6] Consult here Arber and Parkin's paper on the Gnetales, in *Annals of Botany,* Vol. XXI. (1908), p. 489.

compact strobili of open microsporophylls and megasporophylls upon the microphyllous, solid-woody sporophyte.

I regard the cone-bearers proper—*Taxodiaceae, Araucariaceae, Abietaceae, Cupressaceae,* etc., as more primitive, and that from these have sprung such specialized forms as *Podocarpaceae, Phyllocladaceae* and *Taxaceae.*

From the *Cycadophyta* came also the fifteenth phylum—

15. *Anthophyta,* in which the dominant idea is the closure of the megasporophyll, and the transformation of the plain strobilus into the ornamental flower.

I am very glad to be able to suggest the restoration of the wholly appropriate name —*Anthophyta*—for this phylum. As I conceive this immense group, it is rather sharply divided into three secondary phyla which diverge from a common point of beginning—the so-called "Ranalian plexus." Two of these secondary phyla are dicotyledonous, while the third is monocotyledonous. The first culminates in the mints (*Lamiales*), the second in the sunflowers (*Asterales*) and the third in the orchids (*Orchidales*).

With regard to the relationship of the four phyla last named many facts have been brought to light during the past few years, which have quite materially modified the generally prevailing theories. With the publication of Wieland's epoch-making book on American cycads[7] attention has been centered upon the primitive cycads as the group of gymnosperms from which the angiosperms must have sprung. It is no longer a tenable hypothesis that the conifers are allied to the Amentiferae, as has long been held by many botanists. It is no longer necessary to begin the phylogeny of angiosperms with apetalous forms so as to make easier the passage from Coniferae. In fact, for many years there have been those who held that apetalous plants are not primitive, but on the contrary have been derived from petalous forms by reduction. Sixty years ago or more Jussieu hinted at the real nature of apetalous plants[8] and suggested the primitive nature of the Ranales, and consistently placed the Compositae at the summit of his system.

In the vice-presidential address[9] which I had the honor of delivering before this section fifteen years ago, after a careful examination of the families in the so-called Apetalae the conclusion was reached that "when we search for families in the Apetalae which may satisfy the requirements of a primitive group from which the dicotyledons may have evolved, we find none which will serve our purpose." Following the hint of Jussieu, the attempt was made to distribute the apetalous families among polypetalous and gamopetalous orders. A revision of the monocotyledonous and dicotyledonous orders was made so as to bring the apocarpous families near the beginning (lowest) point. Thus the water-plantains (*Alismales*) were given the first (lowest) place among monocotyledons, and buttercups (*Ranales*) and roses (*Rosales*) similar places among dicotyledons. From the water plantains (*Alismales*) a phyletic line was traced through the lilies (*Liliales*) to the modified (simplified) calla lilies (*Aroidales*), palms (*Palmales*) and grasses (*Graminales*), which form lateral offshoots of the main line, and then onward from lilies (*Liliales*) through irises (*Iridales*) to orchids (*Orchidales*). In like manner a phyletic line was traced from buttercups (*Ranales*) to pinks (*Caryophyllales*), prim-

[7] "American Fossil Cycads," by G. R. Wieland, 1906.

[8] "The Elements of Botany," by Adrien de Jussieu; translated by Wilson, 1848, p. 543.

[9] *Proceedings* of the American Association for the Advancement of Science, Vol. XLII., 1893, p. 245.

roses (*Primulales*), phloxes (*Polemoniales*) to figworts (*Personales*) and mints (*Lamiales*). Another line was sketched from roses (*Rosales*) to umbelworts (*Umbellales*), madders (*Rubiales*) and sunflowers (*Asterales*). Certain details of that arrangement, as the disposition of *Celastrales* and *Sapindales*, and the retention of the *Choripetalae* and *Gamopetalae* as valid groups, were subsequently found to be erroneous, and were corrected, but in the main the system as then outlined has been sustained by subsequent careful studies of the families.

Two years later[10] this general arrangement was expanded so as to include brief characterizations of the orders, suborders and families, and in it the *Celastrales* and *Sapindales* were brought into the phyletic line extending from *Rosales* to *Asterales*, but the *Choripetalae* and *Gamopetalae* were still recognized as valid groups.

A year later, in an elementary textbook[11] the *Choripetalae* and *Gamopetalae* were abandoned as definite groups of angiospermous orders, since it is evident that gamopetaly has been attained independently in at least two phyletic lines.

In my presidential address[12] before the Botanical Society of America in 1897, the dicotyledons were arranged in "two somewhat diverging genetic lines or phyla, each beginning with apocarpous, hypogynous, choripetalous plants, and both attaining syncarpy and gamopetaly, one remaining hypogynous, the other becoming epigynous." A little later it is explained that "since gamopetaly has evidently been attained at more than one point, it is no longer desirable to retain the *Gamopetalae* as a distinct group."

The latest restatement of this arrangement of the flowering plants was published at the beginning of the present year in my "Synopsis of Plant Phyla,"[13] already referred to earlier in this address. In it many minor corrections were made, and some suggestions were hazarded as to the point of origin of angiosperms, and conifers. These suggestions followed the line sketched by Arber and Parkin in their paper on the "Origin of Angiosperms"[14] published a few months earlier. Basing their argument upon the discoveries of Wieland[15] these authors concluded that angiosperms were derived from Cycadean ancestors of the Bennettitean type, with an open flower-like strobilus ("pro-anthostrobilus") of megasporophylls, microsporophylls ("amphisporangiate") and asporophylls ("perianth"). As a consequence they arrive at the conclusion that primitive angiosperms were necessarily polypetalous, hypogynous and apocarpous, precisely the conclusion reached by me on theoretical grounds more than fifteen years ago, and since then persistently held in the face of the increasing popularity of Engler's system. It would now appear probable that there must soon be another rearrangement of the flowering plants. We have recently witnessed the almost complete inversion of the sequence of the families of flowering plants in our systematic manuals, and it appears now that we shall barely have time to become accustomed to the new order before we shall have to learn still another. It seems now inevitable that such orders as

[10] In Johnson's "Universal Cyclopedia," Vol. VIII. (1895).

[11] "The Essentials of Botany," sixth edition, 1896, p. 322.

[12] "The Phylogeny and Taxonomy of Angiosperms," August 17, 1897. Published in *Botanical Gazette*, Vol. XXIV., p. 145.

[13] "A Synopsis of Plant Phyla," in *University of Nebraska Studies*, October, 1907 (issued February, 1908).

[14] "The Origin of Angiosperms," by F. A. Newell Arber and John Parkin, in *Linnean Society's Journal—Botany*, Vol. XXXVIII., July, 1907.

[15] "American Fossil Cycads," 1906.

the buttercups (*Ranales*), water plantains (*Alismales*), and roses (*Rosales*) are to be regarded as primitive, and as a consequence they must stand at the beginning of the great phylum *Anthophyta,* as also each must stand at the beginning of its smaller phylum. That the phylum beginning with the water plantains (*Alismales*) must find its highest development in the irises (*Iridales*) and orchids (*Orchidales*) can not be doubted; nor can it be questioned that grasses (*Graminales*), calla lilies (*Aroidales*) and palms (*Palmales*) must now stand as reduced from the type of the lilies (*Liliales*). This leaves no room for radical differences of opinion, and in fact little room for any but the most minor differences in regard to the proper sequence of the monocotyledonous families.

In like manner beginning with the Ranalian type in the dicotyledons, it is obvious that one phyletic line culminates in the gamopetalous, bicarpellate, hypogynous order of the mints (*Lamiales*), while another passes through the roses (*Rosales*) (if indeed they are not themselves primitive), and umbelworts (*Umbellales*) to the sunflowers (*Asterales*). Here again, with regard to the details as to the intermediate orders there may be much difference of opinion. Yet there will be no question that in one line the pinks (*Caryophyllales*) and mallows (*Malvales*) are lower than primroses (*Primulales*) and heaths (*Ericales*), nor that the latter are lower than phloxes (*Polemoniales*) and mints (*Lamiales*). In the other line the myrtles (*Myrtales*) are clearly lower than umbelworts (*Umbellales*), while the latter are manifestly lower than madders (*Rubiales*), and these than sunflowers (*Asterales*). In fact when we agree to the hypothesis that polypetalous, hypogynous, apocarpous flowers are primitive the great outlines of the phylum (or phyla) are quite obvious, and the only questionable points are with reference to the place and sequence of intermediate orders. And it is here that much critical work invites the close attention of taxonomists. The great outlines—the boundaries of the phyla—are drawn, but the particular manner in which many of the interior families are related to each other has not yet been made out.

The principles here brought forward, and the general plan which I have so hastily sketched, have been so serviceable in the presentation of the subject of taxonomy in my lectures to university students that I venture to lay them before you as a general working hypothesis. My own success in its use encourages me in the hope that in the hands of others it may be equally helpful in enabling the student of taxonomy to more clearly apprehend the mode of evolution in the vegetable kingdom, and the consequent relationship of the resulting multiplicity of types.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

THE DARWIN CENTENARY AT CAMBRIDGE

SOME details are given in the London *Times* of the celebration by the University of Cambridge of the centenary of the birth of Charles Darwin and the jubilee of the first publication of "The Origin of Species." It is expected that delegates selected by universities, academies, colleges and learned societies will arrive in Cambridge on Tuesday, June 22, and that the arrangements for their entertainment, which are, however, subject to alteration, will be as follows: On the evening of the twenty-second there will be a reception, probably in the Fitzwilliam Museum, by the chancellor. On Wednesday, June 23, addresses will be presented by the delegates to the university in the senate house. It is hoped to present to each delegate a copy of the first draft of "The Origin of Species." In the afternoon there will be a garden party at Christ's College, where Darwin was a stu-

dent, and in the evening the university will give a banquet. On Thursday, June 24, the Rede lecture will be delivered, and honorary degrees will be conferred. It is further proposed to hold an exhibition of portraits, editions and relics of Darwin at Christ's College, somewhat similar to the Milton exhibition of last June.

Already some 200 delegates have been appointed to represent institutions, including:

Professor W. G. Farlow, American Academy of Arts and Sciences, Boston; Professor C. S. Minot, Boston; Professor R. H. Chittenden, Yale University, New Haven; Professor E. B. Wilson, Columbia University, New York; Dr. J. M. Baldwin, Johns Hopkins University, Baltimore; Professor J. Loeb, University of California, Berkeley; Dr. H. F. Osborn, American Philosophical Society; Dr. L. O. Howard, Academy of Sciences, Washington; Mr. C. F. Cox, Academy of Sciences, New York; Domingo Gana, Universidad de Chile, Santiago; Hofrat Dr. L. von Graff, Gratz; Professor Vejdovsky, Prague; Hofrat Dr. F. Steindachner, Vienna; Professor E. van Beneden, Brussels; Professor H. F. E. Jungersen, Copenhagen; Professor Cuénot, Nancy; M. van Tieghem, Institute de France, Paris; Le Prince Roland Bonaparte, Institute de France, Paris; Professor E. Metchnikoff, Pasteur Institute, Paris; Ober-Regierungsrat Professor Adolf Engler, Deutsche Botanische Gesellschaft, Berlin; Dr. F. von Luschan, Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Berlin; Professor Kukenthal, Breslau; Professor Max Verworn, Göttingen; Professor Bütschli, Heidelberg; Professor R. Hertwig, Munich; Professor Goebel, Munich; Professor E. Ballowitz, Münster; Professor Graf zu Solms-Laubach, Strassburg; Professor Th. Boveri, Würzburg; Professor H. de Vries, Amsterdam; Professor J. H. van Bemmelen, Groningen; Professor A. A. W. Hubrecht, Utrecht; the Italian Ambassador, Marquis of San Giuliano, Società Geografica Italiana, Rome; Professor C. Ishikawa, Tokio; Dr. W. C. Brögger, Christiania; Professor V. M. Simkevic and Professor V. V. Zalenskij, St. Petersburg; Professor H. Théel, Professor Chr. Aurivillius and Professor A. G. Nathorst, Stockholm; Dr. Paul Sarasin, Zurich; the Right Hon. Sir John Buchanan, University of Cape of Good Hope, Cape Town; Sir Richard Solomon, University College, Johannesburg; Professor A. Liversidge, Royal Society of New South Wales, Sydney; Sir E. T. Candy, the University, Bombay; Sir Lewis Tupper, Panjab University, Lahore; Dr. J. C. Willis, Royal Botanic Gardens, Peradeniya; Professor E. Rutherford, Christchurch, New Zealand; Sir Oliver Lodge, Birmingham University; Sir Isambard Owen, Durham University; Dr. A. W. W. Dale, Liverpool University; Sir Archibald Geikie, the Royal Society, London; Lord Avebury, Sir T. Lauder Brunton and Sir E. Ray Lankester, the Royal Society, London; Mr. Francis Darwin, British Association for the Advancement of Science; the Duke of Northumberland, the Royal Institution, London; Sir James Crichton-Browne, the Royal Anthropological Institute, London; Lieutenant-Colonel D. Prain, Royal Botanic Gardens, Kew; Professor G. C. Bourne, Dr. F. Gotch and Professor E. B. Poulton, Oxford University; Sir Charles Eliot, Sheffield University; Mr. R. F. Scharff, Royal Zoological Society, Dublin; Professor W. C. McIntosh, St. Andrews University; Sir William Turner and Professor Cossar Ewart, Edinburgh University; Principal E. H. Griffiths, University College, Cardiff.

WOLCOTT GIBBS

THE death of Wolcott Gibbs takes a commanding figure from the ranks of the veterans of science. Attaining the age of over eighty-six years, he had been for a long time almost the sole survivor among the pioneers of American chemistry. He was one of the founders of the National Academy of Sciences in 1870; and he alone saw his name included among those of living members in 1908.

For over a decade he had headed in academic seniority the list of the faculties of Harvard University. He served there as Rumford professor for twenty-four years, and in honorable retirement bore the title of Rumford professor emeritus for twenty-one years more. The infirmity due to his increasing years had withdrawn from him the privilege of contributing to the growth of his beloved science; but his interest in the work of others remained keen and enthusiastic until the end had almost come—until pain had driven away all the joy of life.

It has been said that he was one of the pioneers of American chemistry. He was made assistant professor in New York at the age of twenty-six in 1848. His eager and energetic spirit and his thorough training

under the inspiring guidance of Rose, Rammelsberg, Liebig, Laurent, Dumas and Regnault had given him an insight into the possible future of chemistry which forbade his contentedly settling down into the mere routine of teaching. Thus at once he joined the then pitifully small band of Americans who sought to advance the bounds of knowledge.

It is impossible here to present a detailed survey of the greatly varied fields in which his work lay, but a brief sketch will give some idea of the activity of his scientific imagination. His first important research concerned the complex ammonia-cobalt compounds, one of the most interesting series among inorganic substances. This masterly work, conducted with the collaboration of F. A. Genth, shed much light upon the puzzling nature of complex compounds in general, and laid the foundation for one of the most elaborate of modern chemical theories. The following years (1861–4) saw him engaged upon a careful study of the platinum metals, upon which he was engaged when he accepted the call to Cambridge in 1863. Shortly afterward (1864) he published for the first time a description of his use of the voltaic current for depositing copper and nickel in such a manner that the deposited metals could be directly weighed—thus providing a simple and exact quantitative method for the analysis of substances containing these metals. The fact that a German, Luckow, afterwards stated that he had used the method for copper before Gibbs had used it, does not detract from the real originality of Gibbs's idea; for Luckow's work was wholly unknown to Gibbs.

From time to time throughout all Gibbs's long period of scientific activity there appeared papers from his pen describing other new and useful methods of quantitative analysis, many of which have been incorporated into the common analytical practise of to-day. For example, his sand-filtering device of 1867 may be said to have been a forerunner of the present admirable apparatus perfected by Gooch and Munroe.

Not long after coming to Harvard, Gibbs turned his attention to the precise use of the spectrometer in chemical investigation, and this work was continued in 1875. Throughout all this time the subject of his work with Genth was only half dormant in his mind, and occasional theoretical or experimental papers concerning the peculiar nature of cobaltamine compounds showed his devotion to his early choice.

Not content with the paradoxes and puzzles offered by these complex bases, or with the other abstruse subjects mentioned, he attacked in succeeding years the complex inorganic acids, composed of various combinations of tungstic, molybdic, phosphoric, arsenic, antimonic and vanadic acids. One can not help wishing, upon studying his patient and careful quest among the bewildering phenomena manifested by these singular substances, that he had had the assistance of modern physical chemistry. But our present knowledge was not then at any one's disposal, and Gibbs did his best with the means at his command, devoting himself for a number of years to the expansion and systematizing of the work in this but slightly cultivated field.

From inorganic chemistry he later turned for a short time to a very different subject, undertaking with H. A. Hare and E. T. Reichert, a systematic study of the action of definitely related chemical compounds upon animals. This research, which appeared in 1891 and 1892, together with occasional previous papers upon organic chemistry, afforded evidence of the breadth of his interest.

Keen as his sense of the importance of physiological chemistry became, it was not keen enough to divert him wholly from his devotion to the rarer substances of the inorganic world, as his following paper on the oxides contained in cerite, samarskite, gadolinite and fergusonite testified.

Although Wolcott Gibbs was essentially an experimentalist, he was one of the first of American chemists to appreciate the importance of thermodynamics. His large library contained all the standard works upon heat, and his influence was the prime factor in having caused the award of the Rumford

medal to J. Willard Gibbs as early as 1880, long before the world at large appreciated the fundamental character of the work of the great New Haven physicist. Wolcott Gibbs served on the Rumford Committee of the American Academy for thirty years (1864–94), and in many other ways did his best to aid the progress of science in America. He was for a time president of the National Academy of Sciences, until ill health enforced his resignation; and he served also as president of the American Association for the Advancement of Science.

Not only at home, but also abroad, his eminence was worthily recognized. His election to honorary membership in the German Chemical Society in 1883 and, to corresponding membership in the Royal Prussian Academy in 1885 is perhaps the most striking evidence of the foreign appreciation of his work. No other American chemist has ever attained to either of these high honors.

The brief autobiography published in the issue of SCIENCE for Friday, December 18, makes unnecessary a repetition of the chief events in his quiet daily life. His manhood was spent partly in New York, partly in Cambridge, and finally during recent years, among his cherished flowers at his home on Gibbs Avenue near the First Beach at Newport, R. I. The circumstances of his early academic life brought him into close contact with but few students. This is the more to be regretted because his enthusiastic spirit, his tireless energy, his generous recognition of everything good, and best of all his warm human friendship endeared him to all who knew him. Those who were thus fortunate, whether students or colleagues, will always devotedly treasure his memory; and his place as a pioneer of science in America will always be secure.

THEODORE WILLIAM RICHARDS

SCIENTIFIC NOTES AND NEWS

THE honorary local secretaries of the British Association for the Advancement of Science to be held in Winnipeg from August 25 to September 1, of the present year, are C. M. Bell, Esq., W. Sanford Evans, Esq., Professor M. A. Parker. Enquiries and communications on matters connected with the meeting should be addressed: To the Local Secretaries, British Association for the Advancement of Science, University Building, Winnipeg, Man.

THE American Society of Zoologists, Eastern Branch, at its recent meeting in Baltimore, elected the following officers: *President*, Professor Herbert S. Jennings, the Johns Hopkins University; *Vice-president*, Professor H. V. Wilson, University of North Carolina; *Secretary-treasurer*, Dr. Lorande Loss Woodruff, Yale University; *Member of Executive Committee*, Professor Maynard M. Metcalf, Oberlin College.

A DIVISION of Food and Agricultural Chemistry of the American Chemical Society has organized and elected the following officers and executive committee: *Chairman*, W. D. Bigelow; *Vice-chairman*, C. A. Brown; *Secretary*, W. B. D. Penniman; *Executive Committee*, F. K. Cameron, H. H. Huston, P. Rudnich, B. E. Curry.

AT the annual meeting of the Academy of Science of St. Louis, Professor Trelease was elected president, and Professor McCourt, recording secretary, for the current year.

PRESIDENT JAMES B. ANGELL, of the University of Michigan, celebrated his eightieth birthday on January 7, while attending the meeting of the Association of American Universities, at Cornell University.

PRESIDENT ELIOT, of Harvard University, expects to leave Cambridge on February 7, for a two-months' trip through the middle west to the southwest and south, during which he will make a large number of addresses to Harvard alumni and others.

DR. ALBRECHT PENCK, professor of geography at Berlin, and this year Kaiser Wilhelm professor at Columbia University, has been given the degree of doctor of science by Columbia University.

THE Wahlburg gold medal of the Swedish Society for Anthropology and Geography will be presented to Dr. Sven Hedin on his return to Stockholm. This is the second

presentation of the medal, it having been given previously to Professor G. Retzius.

Professor Theodore W. Richards has received a seventh grant of $2,500, and Assistant Professor Gregory P. Baxter a fifth grant of $1,000, from the Carnegie Institution of Washington, to aid in researches upon physico-chemical constants.

Mr. E. R. Lloyd, Rhodes scholar at Oxford from West Virginia, who was placed in the first class in the final honor schools, has been awarded the Burdett-Coutts scholarship in geology, which is held for two years and is of the annual value of £115.

King Edward has appointed Dr. H. R. D. Spitta to be bacteriologist to his household.

Mr. Raphael Zon, who will have charge of the forest experiment station work in the reorganized Forest Service, is now abroad studying the stations in Europe.

Mr. C. A. McLendon has resigned the position of assistant botanist and plant pathologist at the South Carolina Experiment Station to accept the position of botanist and plant pathologist at the Georgia Experiment Station, Experiment. He takes the place recently vacated by the removal to the State College, at Athens, of Professor R. J. H. De Loach.

It is announced that Professor George Hempl, of Stanford University, has made important discoveries in the interpretation of inscriptions left by the Etruscans.

Professor S. A. Mitchell, of Columbia University, on successive Saturday evenings, beginning January 9, delivers a course of lectures on "Astronomy" at the Wagner Institute, Philadelphia, as follows: (1) The sun and its motion through space; (2) Eclipses of the sun; (3) Wonders of the heavens revealed by the spectroscope; (4) Foucault's pendulum; (5) The moon; (6) Is Mars inhabited?

The Southern California Science Association was organized at Occidental College, Los Angeles, Cal., on December 12. The next meeting will be held in April at the University of Southern California, Los Angeles. The following officers were elected at the meeting for organization: *President,* W. A. Fiske, Occidental College, Los Angeles; *Vice-president,* W. R. Bowker, University of Southern California, Los Angeles; *Secretary-treasurer,* H. T. Clifton, Throop Polytechnic Institute, Pasadena.

At the meeting of the Middletown Scientific Association, on January 12, Charles Edward Amory Winslow, assistant professor of sanitary biology at the Massachusetts Institute of Technology, gave an illustrated lecture on "Water Supply and Water Purification."

Dr. John A. Brashear lectured at Lehigh University on December 11 on contributions of photography to our knowledge of the stellar universe.

The agricultural faculty and experiment station staff of Clemson College, S. C., have formed an organization to be known as the Clemson Biological Club. Dr. C. H. Shattuck has been elected president and Professor A. F. Conradi, secretary. Regular meetings will be held each week.

The British Admiralty will restore Halley's grave in the old burial-ground of Lee Parish Church. E. Halley, who was the astronomer royal from 1721 to 1742, was given the temporary rank of a captain in the navy, and commanded a ship of war in 1698–1701, for the purpose of making observations for magnetic variations.

A committee has been formed in Denmark to erect a memorial to Mylius Erichsen, who perished with his companions while engaged in explorations in Greenland. It is expected that the memorial will take the form of a lighthouse to be erected on the Danish coast.

A monument to Professor von Krafft-Ebing, was unveiled in the hall of the University of Vienna at the time of the recent international congress in that city on the care of the insane.

It is proposed to erect a building for surgical cases in connection with the Presbyterian Hospital, New York, as a memorial to the late Dr. Andrew J. McCosh. The chairman of the committee having charge of the memorial is Mr. John S. Kennedy, New York City.

The Brooklyn Institute of Arts and Sciences held a Charles Darwin centennial meet-

ing on the evening of January 12, when an address on "Charles Darwin and his Influence" was made by Professor Edward G. Poulton, of Oxford University.

As we have already announced, arrangements have been made for the celebration of the one-hundredth anniversary of the birth of Charles Darwin by the New York Academy of Sciences on February 12 at the American Museum of Natural History. In addition to the presentation to the museum of a bust of Darwin—the presentation to be made by Charles F. Cox, president of the academy, and the acceptance by Henry F. Osborn, president of the museum—addresses will be made on "Darwin's work in botany," by Professor N. L. Britton; on "Darwin's work in zoology," by Professor H. C. Bumpus; and on "Darwin's work in geology," by Professor J. J. Stevenson.

Dr. George Gore, F.R.S., formerly lecturer on chemical and physical science at King Edward's School, Birmingham, the author of works on electrometallurgy and other subjects, has died at the age of eighty-two years.

A recent communication from Vienna announces the death, after a long and painful illness, of the eminent Austrian physicist and meteorologist, Hofrat Professor Dr. Josef Maria Pernter on December 20, 1908, at Arco, Tyrol, Austria. Professor Pernter was the director of the Austrian Central Institution for Meteorology and Geodynamics, Hohe Warte, Vienna, a member of the International Meteorological Committee and vice-president of the Austrian Meteorological Society. His death at the comparatively early age of sixty may leave still incomplete his important "Treatise on Meteorological Optics."

We learn from the *Journal* of the American Medical Association that the recent small epidemic of yellow fever at Saint-Nazaire, on the French coast, has impressed on the authorities the necessity for more effectual measures against yellow fever in the French colonies, whence the disease was imported. The task was entrusted to Drs. Simond and Marchoux, who spent some time in Brazil two or three years ago in study of tropical diseases. They left for Martinique November 11, fully equipped for the extermination of yellow fever and malaria mosquitoes in Martinique and Guadeloupe.

The appropriation bill in which are included the appropriations for carrying on the work of the Bureau of Education has passed the House of Representatives and is now in the Senate Committee on Appropriations. The only increase over appropriations for the previous year made by the House of Representatives is provision for an editor at two thousand dollars per annum. The bureau needs badly provision for larger and more sanitary quarters than it now occupies, a considerable increase in its staff, as well as an increase in the salaries of the present members of the staff, and is endeavoring to secure these increases in the Senate.

A Bulletin from the Harvard College Observatory, under date of January 5, states that the variable star, 154428, R Coronæ was found by Mr. Leon Campbell to be faint on January 1, 1909, magn. 8.2. This star is usually of the magnitude 6.0, but occasionally undergoes marked and apparently irregular diminutions in light, sometimes becoming as faint as magnitude 13. The last diminution in brightness lasted from February 8 to September 6, 1905. On November 12, 1908, its magnitude was 6.1, and on December 13, 1908, it was 6.9. Only two other stars of this class have been as yet discovered, *191033*, R J Sagittarii and 054319—Tauri, the latter being now exceedingly faint. All three of these stars are being followed closely, both photographically and visually.

The *American Museum Journal* states that through Edward L. Dufourcq, the directors of the Minas Pedrazzini Company at Arizpe, Sonora, Mexico, have presented to the mineral cabinet a remarkable specimen of crystallized polybasite. This ore of silver (sulphantimonide of silver with some of the silver replaced by copper) furnishes a large part of the vein material from which the silver is obtained in this mine. At favorable points there have developed beautifully crystallized specimens of the mineral upon a scale of magnitude almost

unique. The entire mass as forwarded consisted of a crystallized surface, displaying small and large crystals, nestling upon an ore body of considerable size. The value in bullion of this aggregate was $640, and it probably was the largest mass of polybasite ever taken from a mine entire.

THE growth of the mineral industries of the United States is graphically exhibited by a chart just issued by the Geological Survey, tabulating for each year of the last decade the quantity and value of the output of our metallic and non-metallic mineral products. This chart shows that in 1898 the domestic production of the metals—pig iron, silver, gold, copper, lead, zinc, quicksilver, aluminum, antimony, nickel and platinum—had a total value of $305,482,183; in the same year the total value of the other mineral products amounted to $418,790,671; the grand total for the country in 1898 was therefore $724,272,854. Ten years later, at the close of the calendar year 1907, the value of the metals had increased to $903,024,005, that of the other products to $1,166,265,191, and the grand total was $2,069,289,196. The chart has interest in connection with a summary of the mineral production of the country, published by the survey as an advance chapter from "Mineral Resources of the United States, Calendar Year 1907," and copies of both the chart and the summary may be obtained by applying to the director of the survey at Washington, D. C. The survey has also published for free distribution separate chapters of its annual report on the mineral resources of the country, giving detailed statistics of many of the products that make up these totals.

Nature states that the council of the Röntgen Society has decided to act upon the advice of the committee appointed in 1906 to consider the possibility of preparing a standard for the measurement of radioactivity. This committee recommends that "The γ-ray ionization from 1 mg. of pure radium be regarded as a standard, and called a unit of radioactivity." The council has deputed Mr. C. E. S. Phillips to prepare a set of three substandards of $RaBr_2$, and these are now maturing. By the cooperation of Professor E. Rutherford, comparison will be made with a specimen of the purest RaBr, at the Victoria University, Manchester. The quantity of radium in other specimens will be capable of accurate measurement by comparison with the substandards. It is anticipated, therefore, that by this means the exact description of medical, physical or other work with radium will be facilitated, and that the possibility of fraud in the sale of expensive radium preparations will be eliminated. The council proposes to lend the substandards to any competent person desiring to measure the amount of radium in his possession, or to arrange for authoritative tests to be made. For further particulars application should be sent to the honorary secretary of the Röntgen Society, at 20 Hanover Square, London, W.

THE following, as we learn from the *British Medical Journal*, are among the prizes awarded by the Paris Académie de Médecine for 1908: The Laborde prize (£200) for the most notable advancement of surgery, has been given to Professor Monprofit, of Angers, for his work on the operative surgery of the stomach; the Theodore Herpin prize (£120) has been gained by Dr. Albert Deschamps, of Riom, for an essay on the diseases of energy—general asthenias; the Amussat prize (£40) has been awarded to Dr. Destot, of Lyons, for a radiographic and clinical study.

UNIVERSITY AND EDUCATIONAL NEWS

IOWA COLLEGE has obtained an additional endowment of $500,000, of which $100,000 is from the general education board and $50,000 from Mr. Andrew Carnegie.

MR. JOHN W. GATES has given $100,000 to establish a college at Port Arthur, Texas.

MR. JACOB H. SCHIFF, of New York City, has given $100,000 towards the construction of a Jewish institute of technology at Haife, Palestine.

WE learn from the London *Times* that the foundations of the laboratory which is being given to the University of Oxford for electrical work by the Drapers' Company are now being constructed. The laboratory will measure

about 104 feet by 92 feet by 51 feet high, and will be built of red brick and stone. It will be situated in the Parks close to the other buildings devoted to science, which are grouped around the museum. The ground floor will contain a class-room 50 feet by 27 feet, a workshop of about the same dimensions, as well as research, battery and dark rooms. On the first floor provision is made for a lecture-hall 36 feet square and two class-rooms over 50 feet long, while on the second floor there will be a class-room about 100 feet long, besides large lecture and research rooms.

THE President of the United States has instructed the Commissioner of Education to aid in all appropriate ways within his power in the carrying out of the plans of the Chinese Government for the education of students in America. The Chinese Government purposes sending 100 students to America every year for four years, and a minimum of 50 students every year thereafter during the period of the cancelled indemnity payments by China to the United States, from 1909 to 1940.

PROFESSOR DONALD J. COWLING, of Baker University, Baldwin, Kas., was elected president of Carleton College, Northfield, Minn., to succeed the Rev. R. H. Sallmon.

MR. W. H. EMMONS, of the U. S. Geological Survey, is giving courses on petrography and economic geology at the University of Chicago.

DR. A. J. GROUT has been appointed first assistant in biology in the Curtis High School, New Brighton, Staten Island.

DR. ARNOLD LANG, of Zurich, has declined the call to Jena as the successor of Professor Haeckel.

PROFESSOR PFLÜGER, of Breslau, has been called to Berlin as director of the Institute of Hygiene in the place of Professor Rubner who has been transferred to the chair of physiology.

DISCUSSION AND CORRESPONDENCE

A DISCLAIMER

HARDLY had the experimental researches at the Nutrition Laboratory of the Carnegie Institution of Washington, located in Boston, been established when the scientific staff were besieged by innumerable newspaper reporters seeking information whereon they could base sensational articles for distribution in the public press. Much to my regret, a lengthy article was distributed broadcast throughout the American press on December 20, purporting to describe the Nutrition Laboratory, the experiments made therein, and the plans for the future. It is needless to say that the whole article was prepared without my knowledge and has left an entirely erroneous impression with regard to the work of this institution.

Briefly, the researches now being carried out in Boston were instituted by Professor Atwater, at Wesleyan University, some fifteen years ago. After Professor Atwater's untimely retirement, I had charge of the researches at Wesleyan University and since then they have been transferred to Boston to a special laboratory. The apparatus used at Wesleyan University has been described in detail in Publication No. 42 of the Carnegie Institution of Washington and a discussion of a series of experiments with it made on man during inanition was reported in Publication No. 77 of the institution. The forthcoming "Year-book of the Carnegie Institution" contains a short statement of the laboratory, the plan, and general information regarding it. The newer calorimeters have not been described as yet. All results of experiments made in this laboratory will be published in regularly accredited scientific journals and in the reports published by the Carnegie Institution of Washington. It has been my policy not to publish original scientific material in popular scientific or semi-scientific magazines, much less would I use the daily newspaper as a vehicle for presenting this material to the scientific public.

In connection with the last newspaper announcement regarding this laboratory, there is a very unfortunate statement that as a result of experiments thus far made in the laboratory, the treatment of diabetes would be materially modified and improved, thus holding out hope to the large number afflicted with this

disease that a speedy recovery might be expected. Indeed, I have already begun to receive letters from these unfortunate diabetics who have thus had their hopes falsely raised.

FRANCIS G. BENEDICT
NUTRITION LABORATORY,
CARNEGIE INSTITUTION OF WASHINGTON,
BOSTON, MASS.

THE LATE PROFESSOR PACKARD'S "GUIDE TO THE STUDY OF INSECTS"

MY father, Professor Alpheus Spring Packard, had purposed to rewrite and bring the "Guide to the Study of Insects" up to date, as soon as he had finished Part II. of his "Monograph of Bombycine Moths," which was going through the press at the time of his death. He left many notes and references in regard to the "Guide," which we had intended to use as a preface, but we find they can not be edited properly by another hand.

ALPHEUS APPLETON PACKARD
NEW LONDON, CONN.,
January 2, 1909

QUOTATIONS

THE ADMINISTRATION AT THE UNIVERSITY OF ILLINOIS

THE University of Illinois has been coming to the front in the last few years more rapidly than any of the other state universities. It now ranks eighth among the great universities of the United States in the number of students, and is receiving large appropriations from the legislature, for the people of Illinois are determined that their own institution shall not be surpassed by any within the state, especially one founded by John D. Rockefeller. More important than its growth is the raising of the standard of scholarship, the introduction of new men of ability and promise, and the opening of a graduate school. This rapid progress is to be credited chiefly to the energy and initiative of President Edmund J. James, who left Northwestern four years ago to take charge of the state university.

But the University of Illinois is suffering somewhat from the twinges of growing pains. Such a radical and rapid transformation can not be effected without hurting the feelings of some one or several. One such, Dr. George T. Kemp, has made his grievance a public question by his articles in the local papers and in SCIENCE of October 9, charging President James with duplicity, dishonesty and abuse of official powers. Dr. Kemp does not ask for sympathy on personal grounds. If his manner of leaving the university has impaired his chances of getting a position in another college, he can fall back on his profession, and make more money by the practise of medicine. But he holds that the question of academic freedom *versus* presidential tyranny is involved in his case, and it is therefore of public importance.

The essential facts seem to be as follows: When the graduate school was established a year ago, certain departments were selected for development, as it was impossible to bring them all at once to this rank. Professor Kemp was not one of the professors promoted, his salary was not raised to the prevailing rate, and his department did not share in the general prosperity. He felt, doubtless rightly, that this indicated that he was not in favor with the administration, and, being a high-spirited man, he resented it as a slight upon his honor and ability. He forced the issue by demanding "a court-martial" before the board of trustees and the formulation of specific charges. This mode of procedure was not adopted, but Dr. Kemp appeared before the board two or three times, presenting witnesses and papers to prove his success as a teacher and investigator, and calling attention to alleged defects in the organization of the university. Then finding the opposition to him still undefined and undiminished, he resigned his position and has since been waging war from the outside against President James and "the system." The board of trustees, regarding his resignation as voluntary, refuses to reopen the case and holds that he had no just grievance against the administration.

Dr. Kemp bases his charge of duplicity and unfair treatment chiefly on the fact that after his last appearance before the board his case was discussed by the president, who at that time stated his opinion of Dr. Kemp and why he did not regard him as worthy of promotion.

We do not see that this charge is well founded. We do not see why the technicalities of legal procedure should be followed in such cases. Certainly our courts are not so prompt and efficient in their action as to commend their methods for extension into academic circles. It is the business of boards to talk over freely the qualifications and defects of the professors, and they would be seriously hampered in their consideration of the subject if the individuals discussed had to be present or represented by attorney.

The reason why no definite and serious charges such as would necessitate his dismissal were brought against Dr. Kemp was probably because there were none to bring. The president seems to have objected to him on the ground that he was not a first-class teacher or administrator and that he was a hard man to get along with. These are as intangible as they are important, and it is difficult to see how they could be proved or disproved by any form of court-martial. President James practically appealed to the trustees to express their confidence in his judgment of men, and this is what they have done. Since to be a good judge of men is one of the most important qualifications of a college president, they could hardly have decided against him if they thought him worthy of office. It may be that President James underestimated Dr. Kemp's ability and overestimated his incompatibility, but the error, if it were such, does not involve any moral obliquity. The University of Illinois should have the best physiologist it can find, and it is not clearly demonstrated that Dr. Kemp is that man.

We believe that the board of trustees are right in holding that further discussion of the case is unnecessary and detrimental, although we do not regard their resolutions, reported in *The University of Illinois Press Bulletin* of December 16, as satisfactorily worded. We do not find in Dr. Kemp's letter of resignation the reasons they quote as his. The letter as published in SCIENCE gave altogether different reasons. And the statement made by the board that Dr. Kemp's resignation was not even suggested at the board meeting is quite too sweeping an assertion.

On the whole, we fail to find evidence to prove that academic freedom is in danger in the University of Illinois or that President James is more autocratic than other successful presidents, as, for example, our revered President Eliot. He certainly is less inclined to be arbitrary and dictatorial than his predecessor, President Draper. We can not here enter upon the wider question of whether a more democratic system of government, such as is advocated by Professor Cattell, is desirable. At present the tendency is to regard a stronger centralized and personal administration as best for universities and cities. The liability to abuse such power is checked by the watchfulness of supervising boards and by the fact that an aggrieved party may appeal to Cæsar, *i. e.*, SCIENCE.—*The Independent.*

SCIENTIFIC BOOKS

Essays on Evolution, 1889–1907. By E. B. POULTON, Hope Professor of Zoology in the University of Oxford. Oxford, Clarendon Press. 1908.

Professor Poulton is well known as an ardent neo-Darwinian and as one who has made the subject of insect mimicry his own, the wonderful collection illustrating this interesting phenomenon in the Hope department of the Oxford Museum being a monument to his enthusiasm, energy and information in this field of investigation. In the volume of essays now under review these two topics are very much in evidence, the essays being for the most part addresses delivered by the author on various occasions, now brought up to date and reprinted. Inasmuch as the essays dealing with the Darwinian theory were originally written before the theory of mutations and Mendelism had become important factors in the question of the origin of species, Professor Poulton has added an introduction to his book dealing with these topics and protesting against the extreme position taken by those whom Professor Hubrecht, himself an upholder of the mutation theory, has lately characterized as "silly antagonists of Darwinism and evolution, who have thought fit to proclaim with a loudness that is in inverse ratio

to the square of their accuracy that Darwinism has been played out since the appearance of de Vries's 'Mutations-theorie.'" It can not be said that Professor Poulton doth protest too much, but he certainly errs in the same direction as those against whom his protest is directed, in that he endeavors, unnecessarily for his purpose, to minimize the importance of both mutations and Mendelism, instead of recognizing them as factors in bringing about conditions upon which natural selection may act.

The first essay is a discussion of the age of the earth, considered from the standpoint of an evolutionist, and had for its exciting cause Lord Salisbury's presidential address to the British Association at the Oxford meeting in 1894. The question is an old one and has had many answers, none of which are very definite, nor does Professor Poulton's discussion of it lead to any more definite conclusion than that the earth must be old enough to have allowed time for the accomplishment of evolution. This will, no doubt, be quite acceptable to evolutionists. Similarly, the second essay, on "What is a Species?" while interesting as a discussion of the meaning that has been applied to the word species at different times, naturally leaves one with a sensation of indefiniteness, and the three succeeding essays, on "Theories of Evolution," "Theories of Heredity" and "The Bearing of the Study of Insects upon the Question 'Are Acquired Characters Hereditary?'" discussions of the respective merits of the old antagonists, Lamarckism and Weismannism, while more interesting reading than the majority of such discussions, yet, again, are quite as futile as these so far as any settlement of the questions at issue are concerned.

The sixth and seventh essays are largely historical. The sixth deals with the views concerning inheritance advanced by the anthropologist, Prichard, in his "Researches into the Physical History of Mankind" (2d edition, 1826). These constitute a remarkable anticipation of the conclusions later advanced by Weismann concerning the non-transmissability of acquired characters, as a quotation of one sentence from the work will suffice to show. Prichard says "changes produced by external causes in the appearance or constitution of the individual are temporary, and, in general, acquired characters are transient; they terminate with the individual, and have no influence on the progeny."

In the seventh essay Huxley's position on the question of natural selection is considered, and it is maintained that he "was at no time a convinced believer in the theory." This conclusion can not but seem strange when one recalls that Huxley received from Darwin the title of "general agent" by the vigor with which he wrote and spoke on behalf of the new theory. Professor Poulton certainly makes out a strong case, claiming that Huxley, while a strong evolutionist, was unable to appreciate the bearings of the theory of natural selection, his inclinations being towards the study of the "engineering side of nature," rather than towards the contemplation of structure in relation to environment. But in opposition to Professor Poulton's conclusion one may oppose Huxley's own statements. Writing to Darwin in 1859 he says:

> As to the first four chapters [of the Origin], I agree thoroughly and fully with all the principles laid down in them. I think you have demonstrated a true cause for the production of species, and have thrown the *onus probandi*, that species did not arise in the way you suppose, on your adversaries.

True, he goes on to confess that he did not feel that he had fully realized the bearings of the theory of natural selection, and criticizes the adoption of the principle that *natura non facit saltum* and the slight importance assigned to continued physical conditions as a cause of variations. These criticisms do not, however, apply to the theory of natural selection; they concern only the question of the origin of variations. Further, writing in 1880, he said:

> I hope you do not imagine because I had nothing to say about "natural selection [in "The Coming of Age of the Origin of Species"], that I am at all weak of faith on that article. On the contrary, I live in hope that as paleontologists work more and more . . . we shall arrive at a

crushing accumulation of evidence in that direction also.

These statements can hardly be regarded as those of an unbeliever, but suggest the possibility that Professor Poulton is speaking in his essay as a neo-Darwinian, an upholder of the doctrine of the all-sufficiency of natural selection.

The latter part of the Huxley article and the remaining three essays are devoted to a consideration of the question of insect mimicry. They are the *pièces de résistence* of the whole volume, forming, as they do, the most thorough exposition of the significance of insect coloration we possess or are likely to possess until the fuller treatise promised by the author is published. In the abundance of illustrations cited and in the keen criticism to which the various cases are subjected the essays stand alone, and their usefulness is immensely increased by the addition of a list of the mimicking and mimicked forms referred to, and also by the most complete and thorough index to the entire volume that it has ever been the present reviewer's pleasure to use. If any points may be selected for special mention from a treatise whose general excellence is so high, they are the evidence advanced tending to place the Mullerian theory of common warning coloration on a firmer basis, and the extension of its applicability to a greater number of cases at the expense of the Batesian theory of mimicry.

What has been said above is intended as a review of the book from the standpoint of a biologist. To non-biological readers the perusal of every essay will be both pleasurable and profitable; pleasurable because Professor Poulton's style is admirable and both his description of facts and his statement of criticisms clear, and profitable because his information concerning the topics of which he treats is extensive. Accuracy is never sacrificed to an attempt to popularize the subject; such a defect is unnecessary in the writings of one who has so marked a faculty for the exposition of scientific topics in a manner intelligible to the general reading public.

J. P. McM.

THE GENERA OF AFRICAN PLANTS

THE agricultural, commercial and industrial activity of Europeans in Africa has been so great of recent years that the interior of that great continent has become to-day perhaps the most eagerly exploited field in descriptive botany, not even excepting the Philippines under American administration.

Though the British and French pretty evenly divide honors in the earlier study of African botany, and the former are likely long to maintain their lead in knowledge of the Cape flora, other nations have contributed very materially to our knowledge of the dark continent; and despite the fact that England was the first to press into the tropical interior, the present development of the latter has fallen largely to the Germans and Belgians.

To botanists possessed of collections of African plants, no recent publication is likely to be more directly and frequently helpful than Thonner's "Blütenpflanzen Afrikas."[1] This stately volume brings together in synoptical form the scattered skeletal elements of the flora as a whole. Nomenclature, taxonomy and general ideas of segregation follow the Berlin practise. Well-contrasted keys are provided for the differentiation of families, and, under them, of genera: and the illustrations, from original drawings, simplify the application of text-characters. Indexes to popular and Latin names of plants add to the value of the book.

One of the most interesting features of the manual is a tabulated conspectus of the known African plants, which may be summarized as follows:

Distribution.	Families	Genera	Species
Total known	285	9,942	136,000
African	221	3,648	39,000
Indigenous	213	3,486	38,600
North African		981	4,850
Middle African ...		2,185	18,300
South African		1,393	13,300
Insular		1,266	5,950

[1] Thonner, F., "Die Blütenpflanzen Afrikas: Eine Anleitung zum Bestimmen der Gattungen der afrikanischen Siphonogamen," Berlin, Friedländer, 1908, pp. xvi + 673, pl. 150, 1 map.

Though the families not represented in Africa are mostly of local distribution elsewhere and usually little differentiated into genera or even species, a comparatively few, like Magnoliaceæ, Styracaceæ and Polemoniaceæ, are elsewhere widely distributed and extensively differentiated. To one accustomed to the weeds of highly agricultural countries outside the tropics, with extensive interchange of the wares of commerce, the introduced plants of Africa appear peculiar, Araceæ, Zingiberaceæ and Myrtaceæ being prominent among them while our own customary weed groups like Gramineæ, Labiatæ, Caryophyllaceæ, Chenopodiaceæ, Amaranthaceæ and Umbelliferæ are either unrepresented or little prominent.

If a much larger number of thumb-nail details of genera had been substituted for full-plate illustrations of species, and if references had been given to monographs by aid of which the African species of a genus might be determined, the book would have been more useful: but even without these it is going to prove very helpful to those who study African plants in the field, herbarium or garden.

W. T.

Neurological and Mental Diagnosis. A Manual of Methods. By L. Pierce Clark, M.D., and A. Ross Diefendorf, M.D. New York, The Macmillan Company. 1908.

The title of this work is a misnomer. The book might be called a primer of nomenclature of nervous and mental symptoms, with description of the simpler methods of examination technique, but exclusive of all the methods of actual neurological and psychiatric diagnostic reasoning. This holds especially for the neurological part, which gives only a very elementary description of routine of examination which could hardly be called sufficient to lead to a diagnosis in a fairly large number of cases with vital issues involved.

The second part is an epitome of terms and definitions in psychiatry and ways of getting hold of the corresponding facts, with the addition of a standard case for each of the three standard types of dementia præcox, for dementia paralytica or paresis, melancholia, "the" two forms of manic-depressive insanity, paranoia, alcoholic hallucinosis and amentia, arranged in the set formula assumed for the average examination. This is followed by twenty-eight pages of a "glossary of terms commonly used in psychiatry," adding materially to the scholastic tenor given the whole presentation. Very satisfactory photographs of the patients accompany most of the histories. The photographs and drawings of the neurological part give the positions in testing for reflexes, and the points of electric stimulation and the sensory segments.

There is no doubt about the desirability of outlines of examination, especially if they are sufficiently perspicuous in the arrangement of topics and the various steps to be followed to serve *during examinations*, and if they are small enough to be carried in the pocket, or still better, if they serve as a sort of portfolio, as a support in writing, as well as a protection against oversights. Neither of these purposes is served by the book, nor can it be called more than a partial summary of the ordinary methods and their technique, with the chief point, namely, the safeguards about interpretation, left practically untouched.

As a sample specimen of the neurological work a composite case record—under the best of circumstances likely to be a libel against nature—is furnished with the heading:

Oct. 1, 1907. William Johnson, 36, s., Eng., in U. S. 10 years.

Diagnosis: Tabes Dorsalis.

In the course of the not especially clearly arranged notes, without any evidence of change of heading or diagnosis or suggestion as to what was aimed at, we find the man married at 22, with 3 children; then—"one year ago (Oct., 1904)" a symptom-complex suggesting cerebral syphilis is credited to him, and in the direct examination the patient is a "blond German," but still 36 years old. The chief danger of records, the prevalence of form over sense, is unnecessarily and unintentionally exemplified.

In the review of the methods in a mental diagnosis the essential facts of the neurological diagnosis are done over. The general

plan of psychological examination may have the advantage of didactic simplicity, but it will lead rather to the picking out of a verbal diagnosis than to an understanding of the meaning and spirit of the disorder of the patient.

The mental cases given are clear but very elementary and there is very little help towards finding the way, where actual difficulties would arise.

In a future edition the grouping and the interpretation and utilization of the results should be given better attention, and by using different types of print the important and obligatory steps might be put into contrast with the matters to be used to settle less common difficulties.

A. M.

SCIENTIFIC JOURNALS AND ARTICLES

The Bulletin of the Charleston Museum for November comprises Notes on Taxidermy, Library News, Notes from the Museum and notices of The Natural History Society. The sound advice is given to those interested in taxidermy to practise on English sparrows and not endeavor to mount a bird until they can put up a good skin. The library possesses some interesting portraits of former officers and a bust of Bachman.

The Museum Journal of Great Britain for November contains accounts of the "Oxford Museum Jubilee" and the "Museum Conference in Rochdale" and "The Arrangement of an Egyptological Collection," by W. E. Hoyle. This comprises a suggested classification of exhibits and three alternative schemes for arrangement, chronological, topical and ideal, the latter being an effort to present a general view of Egyptian civilization. Arthur Fairbank presents the plans for "The New Building for the Museum of Fine Arts in Boston."

The Zoological Bulletin, Division of Zoology, Pennsylvania Department of Agriculture, though dated September 1, has only recently been received. It is devoted to a "First Report on the Economic Features of Turtles of Pennsylvania" and is a companion volume to the serpents of Pennsylvania previously issued. The report comprises descriptions of all the turtles found in Pennsylvania, with accounts of their habits, value as food, and their beneficial or harmful character as indicated by the plants and animals on which they feed. The large amount of information as to habits and the food of turtles makes the paper particularly valuable. Half-tone plates, mostly provided from the American Museum of Natural History, are given of the various species and there are also in the text many most excellent pen drawings by W. R. Walton. Two original plates show good series of the variable and closely related species *Chrysemys marginata* and *C. picta*. Mr. Surface is to be congratulated on having placed so much information within reach of so many readers.

SPECIAL ARTICLES

THE TEXAS TERTIARIES—A CORRECTION

THE original section of the Texas Tertiary published in the *Journal of Geology* for 1894 made the Eocene end with the Frio substage of the Claiborne, which was followed immediately by the Oakville beds of supposedly Miocene age. Based on this classification and on the decision of Professor G. D. Harris that fossils found in sandstones just north of Corrigan were of Claiborne age, Mr. Kennedy referred these sandstones to the Fayette sand and the overlying or Fleming clays to the Frio. Larger collections from this locality made later by Mr. Veatch proved the Jackson age of the sandstones and this implied a similar wrong assignment on our part of the Frio clays. From Mr. Veatch's statement in his report "Underground Water Resources of Northern Louisiana and Southern Arkansas," he evidently considered the reference of the Corrigan beds as made by Kennedy incorrect, and our recent stratigraphic work on them has proved this to be true.

On the Rio Grande, Nueces and San Antonio rivers, and probably on the Colorado, the original section holds, and the Frio beds which carry Eocene fossils in places are immediately overlain by the Oakville. In the eastern part of the state, however, beds of Jackson age appear in places between the Frio and Oakville.

On the Houston East and West Texas Railway, the sands which really represent the Fayette beds occur around Lufkin, but the exposures on the railroad, where the section was originally made, are so small that they were considered as simply a part of the Yegua beds, which were thereby given a much greater areal distribution than elsewhere and made to include the overlying Frio clay as well.

The contact between the Yegua and Fayette should have been given as just north of Lufkin and the Frio clays should have been shown as occupying the area between Burke and the top of the bluff on the south bank of the Neches River. At this latter point, we have the contact of the sandy limestone containing Jackson fossils, and this is overlain by the Fleming-Burkeville beds, while the Oakville sands appear just south of Corrigan. Similar conditions exist east and northeast of Corrigan to the Sabine River, and it is altogether probable that some of the deposits lying to the west and classed by Kennedy as Navasota beds may belong to this same horizon.

The same section is also shown on the Conchas River in Tamaulipas, Mex., where the Fayette sand, with its characteristic fossil *Ostrea alabamiensis* var. *contracta* is overlain by the Frio clays and these in turn by sandstones with a distinct Oligocene fauna.

It would therefore appear that while the Oligocene was probably laid down entirely across this area, it is now covered in many places by the overlapping Oakville.

E. T. Dumble

THE SIXTIETH MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, BALTIMORE, MD., DECEMBER 28–JANUARY 1, 1908–9

One of the most successful meetings in the history of the American Association, and in some regards the most successful, was brought to a close Friday evening, January 1, 1909, at Baltimore. Ample provisions for a large meeting were made by the local committee, and the expectations were fully realized. The total registration of the members of the association was 1,088 and the affiliated societies reporting adds 117. The next largest registration to this was at Washington, in 1903, when 903 were recorded. But, as always, many in attendance were not registered, and a conservative estimate would bring the attendance of scientific men up to about 2,000. One striking feature in the attendance was the large number of men from the various government services in Washington, who came over and lent their presence in the meetings of every section.

Great credit is due to the energy and efficiency of the local committee, of which Professor Wm. H. Welch was chairman and Professor Wm. J. A. Bliss secretary. The meeting places, mostly in the buildings of the Johns Hopkins University and Medical School, were ample and convenient, and the hotel accommodations excellent. There was not a hitch in the carrying out of the program; every want was provided for in advance.

The opening session was held in the audience room of McCoy Hall, Johns Hopkins University, at 10 A.M. Monday, December 28, 1908, with the retiring president, Professor E. L. Nichols, of Cornell University, in the chair, who introduced the incoming president, Professor T. C. Chamberlin, of the University of Chicago, who presided. Addresses of welcome were made on behalf of the educational institutions of the city by President Ira Remsen, on behalf of the local committee by Dr. Wm. H. Welch and on behalf of the city of Baltimore by the mayor, Hon. J. Barry Mahool. It was recalled that when the association met in Baltimore fifty years ago, the membership was only 1,000 and the attendance at the meetings only 200, while now the membership has grown to 7,000 and the association has been divided into eleven sections, each devoted to a phase of scientific work, and even sections subdivided, in the case of Section C, chemistry, there being eight subsections, each with large attendance, and papers enough to occupy two or three days in the reading.

The presidential address by Professor E. L. Nichols, of Cornell University, was given in the hall of the Peabody Institute before a large audience of members and citizens of the town. The address was a masterly presentation of the thought that all the material advance of society is based on the discovery of laws and the establishment of principles by research in pure science; that the most of this research and of these contributions up to date have been made in lands across the sea; that our universities are not properly providing for research, and that great improvement along these lines is possible, the recent noble bequest of Senator Vilas to the University of Wisconsin for the endowment of research professorships pointing the way.

After the presidential address a reception to the members of the association and affiliated societies was tendered by President Ira Remsen at McCoy Hall. The reception was largely attended and was a very pleasant affair.

Sectional meetings began on Monday afternoon, and were continued till Friday evening, when all papers were read or otherwise disposed of. Certain of these sectional meetings were favored with record attendance, and with programs of exceptional interest and value. Section B reports the most successful meeting of its history. The joint meeting with the American Physical Society gave a record attendance. It was probably the largest gathering of physicists that has ever occurred in America. Eight sessions were held, and 54 papers presented. The dinner held at the Country Club on Tuesday evening had a.. attendance of 91 and was voted the pleasantest event in the history of the section.

Section E, in affiliation with the Geological Society of America, held a memorable symposium on "Correlation in Historical Geology." Sixteen papers were presented in this symposium, running through six sessions. A feature was a remarkable series of maps by Mr. Bailey Willis, showing the paleogeography of the continent of North America in many stages of its formation up to the present, showing what was certainly land, and certainly sea, areas sometimes land and sometimes sea, and the areas of uncertainty. Quite significant was the presentation of the logic of correlation by Professor T. C. Chamberlin, the first term in every series of phenomena to be interpreted being shown to be found in diastrophic changes.

The most important event in the week for Section F was the vice-presidential address by Professor E. B. Wilson, on "The Determination and Inheritance of Sex."

Section L reported a very successful series of meetings, thus proving the wisdom of its establishment last year. This section has adopted the plan of devoting each session to the discussion of a single topic. On Wednesday afternoon American College Education was the theme, discussed by Professors Josiah Royce, James H. Tufts and others. In his address as retiring vice-president Commissioner Elmer E. Brown pointed out effectively the chaos that exists in American educational standards, and defined clearly some of the problems that must be solved to bring order out of this chaos. A session was devoted to the discussion of the needs and possibilities of the U. S. Bureau of Education.

The affiliated societies meeting with the association this year were the American Society of Naturalists, the American Society of Biological Chemists, the American Anthropological Association, the American Folk Lore Society, the American Philosophical Association, the American Physical Society, the American Psychological Association, the American Physiological Society, the American Society of Vertebrate Paleontologists, the American Chemical Society, the American Society of Zoologists, the American Nature-study Society, the American Mathematical Society, the American Federation of Teachers of the Mathematical and the Natural Sciences, the American Institute of Electrical Engineers, the American Alpine Club, the Association of American Geographers, the Association of American Entomologists, the Botanical Society of America, the Entomological Society of America, the Geological Society of America, the Society of American Bacteriologists, the Association of American Anatomists, the Southern Society for Philosophy and Psychology, the Sullivant Moss Society and the Wild Flower Preservation Society.

Some actions of the council of the association are of general interest: A resolution was adopted authorizing the permanent secretary to send a letter of greeting to Dr. Martin H. Boyé, of Cooperstown, Pa., the sole surviving founder of the association. It was resolved that the publishers of SCIENCE and *The Popular Science Monthly* be authorized to send *The Popular Science Monthly* in place of *Science* to any members of the association who may specially request it.

An amendment to the constitution was introduced as follows: Amend Article 23, by the omission of the words "and secretary" after the word "vice-president," in the third line, and to insert after the words "preceding meeting," in the fourth line, the following words: "and the preceding secretary, and the presidents and secretaries of those affiliated societies which shall be designated by the council."

One of the pleasantest features of the week was the reception, largely attended, on Tuesday afternoon from 4 to 6:30, by the Maryland Historical Society at its rooms on Saratoga and St. Paul streets.

Quite significant and worthy of attention was the symposium on "Tariff Revision," by Section I on Tuesday afternoon; with papers by Messrs. Farquahar, Hamilton, Orton and Holt, and discussion by Dr. J. Franklin Crowell, of the *Wall Street Journal*, and Mr. Seymour C. Lewis. The recommendation of the last named gentleman, that the laboratory method be introduced into the tariff

management, by establishing a bureau in the Department of Commerce and Labor, composed of experts, who will make scientific studies and recommendations to Congress, so removing the question from partisan politics.

Another valuable meeting was the symposium on "Public Health" in McCoy Hall on Thursday afternoon, with addresses by Dr. Harvey W. Wiley, of the Bureau of Chemistry, Washington, on "The Nation's Pure Food Problem"; by Dr. L. O. Howard, on "The Economic Loss due to Insects that Carry Disease"; by Dr. Horace Fletcher, on "Vital Economics"; by Professor Irving Fisher, of Yale, on "Progress of the Movement for Health Reform"; and by Dr. Walter Wyman, of Washington, on "Public Health Administration." The very great preventable waste of human life, which is going on around us, was forcibly presented, and recommendations made for our government to take an intelligent and earnest interest in conservation of health as our greatest resource.

The crowning feature of the week was the Darwin Centenary Memorial. The entire day, Friday, was devoted to the celebration. The great audience room of McCoy Hall was filled to the doors during the presentation of the papers. The president of the association, Dr. T. C. Chamberlin, presided and opened the session with an address. Then followed Dr. Edward B. Poulton, of Oxford University, England, who spoke very entertainingly of "Fifty Years of Darwinism"; Professor John M. Coulter, of the University of Chicago, spoke on "The Theory of Natural Selection from the Standpoint of Botany"; and Professor E. B. Wilson, of Columbia University, discussed "The Cell in Relation to Heredity and Evolution." In the afternoon session Dr. Daniel T. MacDougal, of the Carnegie Institution, told of the "Direct Effect of Environment"; Dr. S. W. E. Castle, of Harvard University, explained "The Behavior of Unit Characters in Heredity"; Dr. Charles B. Davenport gave an account of "Mutation"; Dr. Carl H. Eigenmann, of Indiana University, discussed "Adaptation"; Professor Henry F. Osborn, of Columbia University, gave "Recent Paleontological Evidence of Evolution." This series of addresses will be issued as a memorial volume a little later in the year.

The close of the week's functions was the Darwin memorial dinner at Lehman's Hall. About 300 sat at table, and after the repast the president of the association, Dr. Chamberlin, presented Professor H. F. Osborn as the toast-master. Professor Osborn gave an interesting reminiscence of his youth, when working in Huxley's laboratory. Darwin visited the place, as the guest of Huxley, and the young Osborn, being the only American present, was introduced to Darwin. He spoke also of the spirit of Darwin and of Huxley which came to Johns Hopkins with Martin and with Brooks, both now gone. Professor Wm. H. Welch was then introduced and spoke of "The Debt of Medicine to Darwin"; Dr. Albrecht Penck, of the University of Berlin, spoke on "The Geographical Factor in Evolution," and Professor Edward B. Poulton, of Oxford, gave a lively and entertaining talk on "The Personality of Darwin." Then Professor Chamberlin closed the meeting with words of thanks and praise for those in Baltimore who so splendidly entertained the association.

At the final general meeting on Friday morning a resolution, introduced by Mr. Edward W. Morley, was passed, as follows:

Resolved, That the American Association for the Advancement of Science sincerely thanks the Johns Hopkins University and the other institutions of the city and also the citizens of Baltimore, for their generous hospitality during our meeting.

At the meeting of the general committee it was voted to hold the next meeting during convocation week, 1909–10, at Boston, and recommendations to following councils favoring successive annual meetings at Minneapolis, Washington, Cleveland and Toronto. It was voted that a summer session in 1910 at Honolulu would be desirable if suitable arrangements can be made.

Officers were elected as follows: President, Dr. David Starr Jordan, of Leland Stanford University; General Secretary, Professor Dayton C. Miller, Case Scientific School, Cleveland; Secretary of Council, Dr. F. G. Benedict, of the Carnegie Institution; Secretary of Section H, Professor George Grant McCurdy, of Yale University; Secretary of Section K, Dr. G. T. Kemp. Vice-presidents of the various sections were elected as follows: Section A, Professor E. W. Brown, of Yale University; Section B, Dr. L. A. Bauer, of the Carnegie Institution; Section C, Professor Wm. McPherson, of Ohio State University; Section D, Mr. J. F. Hayford, of the U. S. Coast and Geodetic Survey, Washington; Section E, Dr. R. W. Brock, director of the Canadian Geological Survey; Section F, Professor W. E. Ritter, University of California; Section G, Professor D. P. Penhallow, McGill University, Canada; Section H, Professor Wm. H. Holmes, chief of the Bureau of Ethnology, Washington; Section I, Dr. Carroll D. Wright, of Clark College; Section K, Professor C. S. Minot, Harvard University; Section L, Dr.

James E. Russell, Teachers College, Columbia University.

J. PAUL GOODE,
General Secretary

UNIVERSITY OF CHICAGO

THE AMERICAN MATHEMATICAL SOCIETY

The fifteenth annual meeting of the society was held at Baltimore, Md., on Wednesday and Thursday, December 30–31, in affiliation with the American Association for the Advancement of Science. The total attendance at the four sessions was about seventy-five, including fifty-seven members of the society. Wednesday evening was set apart for a dinner, at which forty-five of the members were present.

The sessions opened at 10:30 A.M. and 2 P.M. on each day. President H. S. White occupied the chair, being relieved by Professor Morley and Vice-presidents Miller and Kasner. At the opening of the afternoon session on Wednesday President White delivered his retiring address on "Bezout's theory of resultants and its influence on geometry." The council announced the election of the following persons to membership in the society: Professor G. N. Armstrong, Ohio Wesleyan University; Professor P. F. Gaehr, Robert College, Constantinople; Dr. Frank Irwin, Princeton University; Miss Mary E. Wells, Mount Holyoke College. Six applications for membership were received. The total membership of the society is now 602, including 55 life members.

At the annual election, which closed on Thursday morning, the following officers and members of the council were chosen:

President—Professor Maxime Bôcher.

Vice-presidents—Professors Edward Kasner and E. B. Van Vleck.

Secretary—Professor F. N. Cole.

Treasurer—Professor J. H. Tanner.

Librarian—Professor D. E. Smith.

Committee of Publication—Professors F. N. Cole, D. E. Smith, Virgil Snyder.

Members of the Council to serve until December, [illegible]—Professors H. B. Fine, O. D. Kellogg, F. R. Moulton, E. J. Wilczynski.

The treasurer's report shows a balance of [illegible].80, including the life membership fund of [illegible].20. Disbursements, including the cost of publishing the *Bulletin* and *Transactions*, were [illegible].97. Sales of publications amounted to [illegible].36. The library now contains over 3,000 volumes. The Annual Register of the society, containing the list of members, constitution and by-laws, annual reports and catalogue of the library, is now in press and will be issued this month.

The following papers were read at the annual meeting:

R. D. Carmichael: "On r-fold symmetry of plane algebraic curves."

R. D. Carmichael: "A general principle of inversion, with applications."

W. R. Longley: "Some sufficient conditions in the theory of implicit functions."

C. L. E. Moore: "Properties of systems of lines in space of four dimensions and their interpretation in circle geometry."

F. R. Sharpe: "The topography of the integral curves of a differential equation."

Joseph Lipke: "Note on isotropic ruled surfaces."

John Eiesland: "On a species of cubic surfaces of the sixth class."

E. O. Lovett: "Integrable problems of three bodies."

J. I. Hutchinson: "On linear transformations which leave an Hermitian form invariant."

H. S. White (presidential address): "Bezout's theory of resultants and its influence on geometry."

Frank Morley: "Plane sections of the Weddle surface."

G. A. Miller: "Finite groups which may be defined by two operators satisfying two conditions."

F. L. Griffin: "Tests comparing the apsidal angles and periodic times for different laws of central force."

E. G. Bill: "Existence 'im Kleinen' of a space curve which minimizes a definite integral."

E. G. Bill: "An a priori existence theorem in three dimensions for the calculus of variations."

J. R. Conner: "Curves and surfaces which admit configurations of the Cayley-Veronese type."

D. D. Leib: "The complete system of invariants for two triangles."

W. A. Granville: "Dual formulas in spherical trigonometry."

C. J. Keyser: "Concerning euclidean geometries without points and lines."

M. E. Sinclair: "The problem of the surface of revolution with two end points variable on circles."

G. A. Bliss: "On the construction of the coordinate system of analytic projective geometry."

O. N. Haskins: "Numerical computation of reaction velocity constants."

Edward Kasner: "The group generated by turns and slides."

Edward Kasner: "Catenaries in an arbitrary field of force."

W. B. Carver: "Degenerate pencils of quadrics connected with $\Gamma^{n+2}_{n+4,n}$ configurations."

C. F. Craig: "On a class of hyperfuchsian functions."

Virgil Snyder: "Surfaces and congruences derived from the cubic variety having a double line in four-dimensional space."

W. B. Ford: "Irreducible homogeneous linear groups in an arbitrary infinite field."

Arthur Ranum: "On certain solids in riemannian space."

Arthur Ranum: "On the rank of a matrix."

H. B. Phillips: "Polygons on a quadric surface."

J. G. Hardy: "Note on a theorem of Pirondini concerning four-dimensional curves."

E. B. Coble: "Combinants of binary forms."

The twenty-fourth regular meeting of the Chicago Section was held at the University of Chicago on Friday and Saturday, January 1–2. The next meeting of the society falls on Saturday, February 27, at Columbia University. The San Francisco Section will meet on the same day at Stanford University. The sixteenth summer meeting and sixth colloquium will be held at Princeton University during the entire week September 13–18. The first two days will be devoted to the regular sessions for the presentation of papers. At the colloquium, which will open on Wednesday morning, the following special courses of lectures will be given: Professor G. A. Bliss, "Existence theorems in analysis"; Professor J. H. Jeans, "Statistical mechanics"; Professor Edward Kasner, "Geometric aspects of dynamics."

F. N. Cole,
Secretary

SOCIETIES AND ACADEMIES

THE INDIANA ACADEMY OF SCIENCE

The annual meeting of the Indiana Academy of Science pursuant to the new plan of holding meetings at the various institutions of learning in the state, was held at Purdue University on November 26–28. A large representation of the educators of the state was present and many papers were read that were of interest and importance. Thirty-five names were added to the roll of the membership, and a number of men who once were residents of the state and active members of the academy were elected to non-resident membership. The retiring president, Professor Glenn Culbertson, of Hanover College, delivered an address on the subject "Deforestation and its Effects among the Hills of Southern Indiana." Significant among the papers read was the number bearing on practical scientific problems. Following is the program in full.

General

"Work of the Pathological Laboratory of the Central Indiana Hospital for the Insane," Dr. Geo. F. Edenharter.

"New Species of Birds in Indiana," Amos Butler.

"The Recent International Congress on Tuberculosis," Severance Burrage.

"Biography and the Influence of Environment," Robert Hessler.

"Felkner Island, Waber Lake, Kosciusko County, Indiana," J. P. Dolan.

"A Strange Nurse," A. J. Bigney.

Drawing of the Indians at "Shaker" (made by an Indian in the Indian School), presented by Albert B. Reagan.

"Invasion of a School Building by Bed-bugs, *Acanthia hirundinis*, parasites on Chimney Swifts," H. E. Enders.

"Photographs of Morehouse's Comet, 1908," (lantern), W. A. Cogshall.

"Selective Fertilization among Fishes," W. J. Moenkhaus.

"Nature Study," J. G. Coulter.

Botany

"Field Observations on Rusts for the General Botanist," J. C. Arthur.

"The Rust of Timothy," F. D. Kern.

"Notes on the Heterecious Rusts of Indiana," Aaron G. Johnson.

"Some Anomalies in the Endosperm of *Pinus*," D. M. Mottier.

"Notes on the Seedless Persimmon," Wm. E. Woodburn.

"A Preliminary List of the Fungi o Indiana," J. M. Van Hook.

"Testing Seed Corn by Specific Gravity," H. A. Dunn.

"Notes on the Flora of Cass County, Indiana," Robert Hessler.

"Bean Anthracnose," M. F. Barrus.

"Endophytic Algæ," Jacob Schramm.

"Report of Work in Corn Pollination," M. L. Fisher.

"Effect of the Recent Drought upon Forest Trees," Stanley Coulter.

"Difference between *Pinus tæda* and *Pinus palustris*," Katherine G. Bitting.

"A Forest Problem," W. H. Freeman.

"Botany in the High School," E. C. Snarr.

"The Killing of Mustard and other Noxious Weeds in the Grain Fields of Dakota," E. W. Olive.

"The Plankton of an Underground Stream," Will Scott.

"Anthracnose on Cereals and Grasses," A. D. Selby and T. F. Manns.

Chemistry, Physics and Mathematics

"The Meyer Molecular Weight Calculation," Percy N. Evans.

"The Vapor Pressure Method of Determining Molecular Weights," J. B. Garner.

"Reaction of Sulphuric Acid Interpreted upon the Basis of the Electrolytic Dissociation Theory," W. A. Ruth.

"Action of Alpha Bromacylesters on Sodium Acetylacetone," G. A. Reddick.

"Action of Alpha Bromacylesters on Sodium Benzoylacetone," J. B. Garner and G. J. Fink.

"Relation of Fats to Moisture Content of Butter," O. F. Hunziker.

"Note on a Class of Definitions," F. R. Higgins.

"A Graphical Representation of the Epsilon-Delta Definition of the Limit of a Function and Continuity," F. R. Higgins.

"The Beckmann Rearrangement," J. B. Garner.

"A Contribution to the Chemistry of Mucoid," C. E. May.

"Determination of Lead by Titration of Lead Chromate," C. E. Brooks.

"An Evolution Method for the Determination of Sulphur in Sulphates and Sulphides," F. C. Mathers.

"The Deterioration of Platinum through Ignition of Phosphates," R. E. Lyons.

"The Use of the Polariscope in Testing High Tension Insulators," C. F. Harding.

Geology

"Probable Origin of Depressions in the Mesa South of the Tijeras Canyon, New Mexico," Albert B. Reagan.

"Headwaters of the Tippecanoe River," J. T. Scovell.

"Origin of Cyclones and Anticyclones of Temperate Latitudes," W. A. McBeth.

"Some Drainage Modifications in Southern Indiana," W. M. Tucker.

"Soil Survey of Davies County," L. C. Snyder.

"Caves and Cave Formation of the Mitchel Limestone of Indiana," F. C. Greene.

Zoology

"The Nasal Muscles of the Reptiles," H. L. Bruner.

"Swell Mechanisms of Vertebrates," H. L. Bruner.

"Life Zones of Indiana as Illustrated by the Distribution of Orthoptera and Coleoptera within the State," W. S. Blatchley.

"Animals of the Olympic Peninsula, Washington," Albert B. Reagan.

"The Effect of Successive Removal on the Rate of Regeneration," Charles Zeleny.

"Proportional Regeneration," M. M. Ellis.

"Curves Representing the Rate of Regeneration," M. L. Durbin.

"Evidences for the Circulation of a Mixed Blood in the Adult Reptile and Amphibian as well as in the Fetal Mammal and Bird," A. G. Pohlman.

The following were elected officers for the ensuing year:

President—A. L. Foley, State University.

Vice-president—P. N. Evans, Purdue.

Secretary—J. H. Ransom, Purdue.

Assistant Secretary—A. J. Bigney, Moore's Hill College.

Press Secretary—G. A. Abbott, Indianapolis Manual Training School.

Treasurer—W. A. McBeth, State Normal.

Editor—H. L. Bruner, Butler College.

J. H. Ransom,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 656th meeting was held on December 5, 1908, Vice-president Wead in the chair. The evening was devoted to hearing the president's annual address, delivered by Dr. L. A. Bauer, who spoke of "The Instruments and Methods of Research."

The full text of this address will soon be published in volume XV. of the Bulletins of the Philosophical Society of Washington.

The 38th annual meeting was held December 19, 1908, President Bauer in the chair.

The following officers were duly elected for the ensuing year:

President—Simon Newcomb.

Treasurer—Bernard R. Green.

Secretaries—G. K. Burgess and R. L. Faris.

General Committee—W. A. DeCaindry, R. A. Harris, E. Buckingham, E. G. Fischer, L. A. Fischer, L. J. Briggs, P. G. Nutting, W. S. Eichelberger, F. A. Wolff.

R. L. Faris,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 449th meeting was held November 28, 1908, with President Stejneger in the chair. Mr. H. W. Clark noted the occurrence of maple seeds gathered into clumps and partly buried n the ground under the trees, without apparent reason. Dr. L. O. Howard cited a new problem in the distribution of the gypsy moth. Distribution has been supposed to be only by caterpillars dropped upon and carried by moving objects, as carriages and the like. Isolated colonies of the moth have now been found in the woods far from roads or paths. The moths can not fly and it is yet unknown how the dissemination was accomplished. Information or suggestions were requested, the point being of much practical importance. The part which birds or heavy winds may play is problematical.

The regular program consisted of an address by Dr. F. Creighton Wellman on the "General Biological Conditions in Angola, Portuguese West Africa." The speaker occupied an hour with an interesting account of general conditions, citing freely from his notes, which were especially rich on the botanical side, on species of both flora and fauna in many groups.

THE 450th meeting was held December 12, 1908, in George Washington University Hall, with President Stejneger in the chair. The program consisted of an illustrated lecture by Mr. Ernest T. Seton, entitled "Two Thousand Miles by Canoe to the Arctic Region."

The 451st meeting, being the 29th annual meeting for the election of officers, was held December 26, 1908, with President Stejneger in the chair. The following were elected for the ensuing year:

President—T. S. Palmer.

Vice-presidents—E. L. Greene, E. W. Nelson, W. P. Hay, J. N. Rose.

Recording Secretary—M. C. Marsh.

Corresponding Secretary—W. H. Osgood.

Treasurer—J. W. Gidley.

Councilors—A. D. Hopkins, A. K. Fisher, A. B. Baker, David White, Vernon Bailey.

M. C. MARSH,
Recording Secretary

SECTION OF GEOLOGY AND MINERALOGY OF THE NEW YORK ACADEMY OF SCIENCES

AT the regular monthly meeting of the section on November 2, the evening was given to the presentation and discussion of a paper entitled "A Contribution to the History of Mt. Pelé, Martinique," by Dr. Edmund Otis Hovey.

The author described, with the aid of many lantern slides, the conditions on and near Mt. Pelé during his visits in May–July, 1902, February–April, 1903, and April–May, 1908, and illustrated particularly the devastation wrought by the early eruptions, the disposition and distribution of material thrown out by the volcano, the building up of the spine of 1902–3 and its subsequent destruction, the advance of erosion since the cessation of eruptions and the restoration of vegetation in St. Pierre and upon the flanks of the mountain. The paper also described the area of fumaroles in the valley of the Riviere Claire and gave the arguments for the probability of these being true fumaroles. Temperature observations were made also in the great fissures of the new cone, where, by means of an electric pyrometer, temperatures as high as 515° C. (959° F.) were obtained.

The paper will be published in full in the *Bulletin of the American Geographical Society.*

CHARLES P. BERKEY,
Secretary of Section

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

THE third regular meeting of the session of 1908–9 was held at the Chemists' Club on December 11.

Messrs. H. S. Miner and M. C. Whitaker presented a paper on "The Rare Earths—their Production and Application." Mr. Miner spoke of the sources of the so-called rare earths, described the forms in which they occurred and the methods of mining and purifying them. He then gave a résumé of the development of incandescent gas lighting, describing the researches of the early workers on the subject and indicating many problems yet to be solved. Mr. Miner illustrated his subject by a splendid collection of raw and purified materials used in making Welsbach mantles. Mr. Whitaker described the manufacturing processes and different forms of mantles used in this country and abroad. He showed numerous lantern slides to illustrate the structure of the mantles and the machinery used in making them.

The other titles for the evening were as follows: "A Volumetric Method for the Determination of Barium," A. E. Hill and W. A. H. Zink; "The Ultra-microscope and some of its Revelations," Jerome Alexander; "The Potential of Iron Calculated from Equilibria Measurements," A. B. Lamb.

C. M. JOYCE,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 22, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

EARTHQUAKE FORECASTS[1]

INTRODUCTION

THERE was a time when the weather belonged to the gods. Storms and drought were inflicted on man in punishment or for vengeance, man strove to avert them by sacrifice or prayer, and the priest was his intercessor. Now the weather belongs to nature, and the priestly robe has fallen on the Weather Bureau. Man's new agent, however, is not an intercessor; he does nothing to placate; he makes no attempt to control the course of nature; but inspired by science he foretells the coming changes so that his lay client may take warning and be prepared. The crops are harvested before the rain, the herds escape from the lowland before the flood, the ships reach harbor before the gale; and man chants a hymn of praise to science.

There was a time when the earthquake was equally enveloped in mystery, and was forecast in the enigmatic phrases of the astrologer and oracle; and now that it too has passed from the shadow of the occult to the light of knowledge, the people of the civilized earth—the lay clients of the seismologist—would be glad to know whether the time has yet come for a scientific forecast of the impending tremor. The outlook for earthquake forecasting is my theme to-day.

As you are aware, I am not a seismologist. My point of view is that of the geologist and general geographer. I speak as

[1] Presidential address to the American Association of Geographers, read at Baltimore, Md., January 1, 1909.

a layman, and present impressions acquired chiefly during somewhat amateurish work on the physical history of the San Francisco earthquake. That event was so far unforeseen that no seismologists were at hand, and the duty of investigation fell, in the emergency, on a volunteer corps of geologists and astronomers. For me it proved a fascinating subject, and interest did not cease with the completion of the special task.

But while this much is offered by way of explanation, and to prevent misunderstanding, you are not to infer that an apology is made because I tresspass on fields to which I have no title, for I am an advocate of the principle of scientific trespass. The specialist who forever stays at home and digs and delves within his private enclosure has all the advantages of intensive cultivation—except one; and the thing he misses is cross-fertilization. Trespass is one of the ways of securing cross-fertilization for his own crops, and of carrying cross-fertilization to the paddock he invades. Hypotheses, the trial theories which compete for development into final theories, spring by the principle of analogy from earlier and successful theories, and the broader the investigator's knowledge of explanatory science the greater his opportunity to discover hypotheses that may be applied to his own problems. Progress is ever through the interaction of the sciences one on another; and scientific trespass is one of the profitable modes of interaction. The trespasser brings with him a mental attitude and a mental equipment which are new to the subject, and whether or no the idea he contributes eventually "makes good," its contribution creates a new category for observation and opens a new avenue of inquiry. And he carries back with him the pollen of new ideas.

Next to verity, the factors which give value to an earthquake prediction are definiteness as to time and place. If the geologist Whitney, in warning San Franciscans forty years ago that their city would suffer by earthquake, had been able to specify the year 1906, and to convince them that he had warrant for his prophecy, the shock, when it came, would have been a phenomenon only and not a catastrophe. If any of those mysterious oracles who were said to have predicted earth convulsions in 1906 had named San Francisco, and told their reasons, the course of history might have been different.

PLACE

Let us consider first the possibility of scientific forecast as to place, and in so doing let us assume the point of view of the resident. The factor in which he is personally interested is the factor of danger—danger to life, danger to property, danger to the present generation. Except as a matter of curiosity, he is not concerned with faint tremors and minor shocks, nor with violent shocks likely to come after centuries of immunity. It will be convenient, at least for this day and hour, to embody our point of view in a concise term, and the adjective *malloseismic* will be used to designate localities likely to be visited several times in a century by earthquakes of destructive violence.

Experience.—The most important of all bases for the indication of earthquake localities is experience. Where tremors have been frequent in the past, there they are to be expected in the future. This premise hardly requires discussion, for it is founded on our confidence in the continuity of the great processes concerned in the evolution of the earth. We recognize indeed that continuity may fail in any particular case, but we always assume it as far more probable than discontinuity.

Other bases for forecast are connected with our conceptions as to the origin of earthquakes. The theory of earthquakes now generally accepted ascribes them to the sudden breaking or slipping of rocks previously in a condition of shearing strain. Exception should probably be made of some of the shocks accompanying volcanic eruptions, but volcanic shocks constitute a class by themselves to which it is not important to extend the present discussion. In non-volcanic, or ordinary, examples it is believed that the strains arise in connection with those tectonic or diastrophic changes which are exhibited superficially in the deformation of the surface, and that their accumulation is gradual. Fracture occurs when and where the internal stress exceeds the strength of the rock, and a fault results. Slipping takes place when the stress along the plane of a preexistent fault exceeds the force of adhesion. In either case it is the instantaneous character of the separation which occasions the jar.

The earthquake being thus a concomitant of tectonic change, its regions of frequency should be found in areas of diastrophic activity, and its occurrence should be rare and sporadic in areas of diastrophic sluggishness. This corollary is so well recognized that seismic activity is commonly regarded as the specific criterion of relatively rapid crustal change. Other criteria of such change are physiographic and geologic, and these may be applied in regions whose earthquake history is unknown. They may also be used, in the absence of seismic records, to give approximate indication of malloseismic localities.

Bold and High Ranges.—It was pointed out by Powell that, because erosion is greatly stimulated by altitude and high declivity, lofty mountains must be regarded as young; and under the principle of continuity young mountains created by uplift are presumably still growing. They are, therefore, phenomena of diastrophic activity and presumably belong to malloseismic districts. The conspicuous example is Mt. St. Elias, which rises boldly 20,000 feet from its base, which was shown by Russell to have continued its growth during the life of the existing marine fauna, and which recently has been signalized by earthquakes of the first class.

Fault Scarps.—Along the bases of block mountains the lines of their limiting faults are sometimes marked by fresh scarps demonstrating recent increase of uplift. In the Great Basin these scarps traverse the alluvium of the piedmont slopes, a surface of such simple type that their presence or absence can be observed with confidence. Their absence suggests diastrophic inactivity or sluggishness, for their effacement is a time-consuming process. Their presence suggests diastrophic activity, and the suggestion is strengthened when their relation to phenomena of weathering and erosion is such as to show that they were produced by a series of recent uplifts instead of one only.

Rifts.—A third physiographic criterion is illustrated in California and was brought to general attention by the San Francisco earthquake. The slip causing that shock occurred on the plane of a fault which outcrops at the surface and has been traced for hundreds of miles. The attitude of the plane is vertical, but the displacement along it was horizontal; and there is reason to think that earlier movements on the same plane were horizontal also, for the fault does not separate a ridge of uplift from a valley of depression but traverses both valleys and mountains. At all points it is included within a belt of peculiar topographic habit, which the investigating geologists have designated as "the rift." Within this belt, which ranges in width from a fraction of a mile

to several miles, are numerous ridges and troughs, long or short, level or inclined, and approximately parallel to the trend of the belt. Each of these represents a dislocated tectonic block, and the dislocation is of so recent date that the disturbed drainage has made little progress toward the restoration of normal conditions. Lakelets are numerous, and streams wander irregularly. Without delaying to attempt a fuller and more adequate description, which may be found in the report of the California Commission,[2] I content myself with an assurance to physiographers that the topographic expression of the rift belt is distinctive, so that it can readily be recognized in other localities by those who have made its personal acquaintance in the field. Other belts of the same character have already been found in California[3] and their discovery elsewhere may confidently be expected.

Rift topography appears to be the surface expression of a species of repetitive horizontal faulting, just as the fault scarp is the surface expression of vertical faulting, and the two types, which with present knowledge are apparently distinct, will doubtless eventually be found to intergrade. The features of the San Andreas rift—the one associated with the San Francisco earthquake—were neither created nor greatly modified at the time of that shock, but such modifications as were made were of such character as to accentuate and perpetuate the peculiarities of the belt. The belt itself would be the natural result of a long series of such events, succeeding one another with such rapidity as to dominate minor aqueous agencies in the modeling of the surface. These considerations, together with the fact that earthquakes are known to have repeatedly originated in the rift belts of California, serve to establish the rift topography as a criterion for the recognition of malloseismic districts.

Geologic Formation.—Fault scarps and rift belts serve to indicate some of the foci of past and future earthquakes. Other foci lie wholly within the earth's crust. Whether the rupture occurs above or below, its jar is propagated through the crust in all directions and affects a large area of the surface. Within this area the intensity of the shock varies primarily with distance from the origin, but it varies also with the character of the geologic formation at the point of emergence. The variation with formation has less range than the variation with distance, but is not less important to the resident and the sojourner, the architect and the engineer—that is to say, it is equally important in forecasting areas of dangerous energy. The portion of San Francisco most intensely racked by the shock of 1906 stood farther from the fault line than the portion least affected, but it stood on less coherent soil. Wood has carefully mapped the distribution of intensity in the San Francisco peninsula, as evidenced by the injury to

[2] California earthquake of April 18, 1906; report of the State Earthquake Investigation Commission; published by the Carnegie Institution, Washington, 1908, pp. 25–52.

[3] The only rift belt beside the San Andreas which has yet been traced for any distance is one which follows in a general way the western base of the Berkeley hills. In the vicinity of Oakland its position is indicated by a trough among the lower hills two or three miles back from the piedmont plain. At Haywards it coincides with the western base of the hills, and at Irvington, with the western base of a projecting spur. In Berkeley also its line follows the base of the hills, but a little northward it climbs to the summit of the first ridge. The principal fault occasioning the earthquake of 1868 was in this rift belt, running from Haywards southward, and it is probable that some of the earlier recorded earthquakes were associated with the same belt. The fault of 1868 is described, and the rift belt is mentioned, in the "Report of the California Earthquake Commission," Vol. I., Part II., pp. 434–5 and 447.

buildings, and shown its close correlation with the distribution of underlying material;[4] and similar, though less detailed, correlations have been made in other regions. On the theoretic side the subject is almost untouched, and there is great need of experimentation, but the empiric results already available have much practical value and enable the geologist and engineer to distinguish broadly, within the limits of a malloseismic district, the tracts more likely, and the tracts less likely, to be affected disastrously by the passing earthquake wave.

On the whole that factor of earthquake forecast which consists in the indication of locality is in a satisfactory condition. In long inhabited regions experience designates certain districts as malloseismic. Newly settled regions may be classified, provisionally and less perfectly, by the data of physiography. And malloseismic districts will eventually be subdivided with confidence by means of geologic criteria.

TIME

Turning now to the time factor in forecasting, and retaining the point of view which emphasizes the element of danger, let us inquire what methods are available for the prediction of the time of occurrence of a destructive earthquake at a given locality or in a given district. Rational attempts to solve this problem have been connected (1) with the idea of rhythm, (2) with that of alternation, (3) with that of the trigger or starter, and (4) with that of the prelude; and each of these lines of approach is worthy of examination.

Rhythm.—Because we are surrounded by and immersed in the rhythms of art and nature, and because the earthquake is a recurrent phenomenon, it is easy to infer that the interval between the last shock and the next will be similar to that between the last and its predecessor. Reasoning of this general tenor probably underlies the greater number of lay forecasts, and is in particular responsible for the wide-spread popular belief that a place recently devastated is *ipso facto* immune for several decades, or at least for several years. A similar belief prevalent among men of science has a slightly different origin, but is even more strongly held; and there is little exaggeration in saying that our guild recognize it is a duty, when the terror-stricken inhabitants of a racked and ruined city seek safety in the open spaces, to assure them that the danger is past and urge them to return to their homes. Now, it is not at all true that either the great shocks or the small shocks affecting a particular locality, or affecting a district, or affecting the earth as a whole, are separated one from another by regular or approximately regular intervals; and it is not at all true that immediate danger is past when a great shock has wrought its havoc; and yet I am prone to believe that the rhythmic principle does hold place in the mechanics of earthquakes. On that point something further will be said, but I shall first invite your attention to the general phenomena of earthquake sequence, selecting examples from the American record because we are most interested in the phenomena of our own territory.

The United States has one well-known malloseismic district, a district including central and southern California, with areas in Mexico and the Pacific Ocean, and possibly extending northward. Alaska also contains a district, and there may be a third in Utah. Since the beginning of the last century, Alaska has experienced at least nine shocks of destructive rank; but the record is fragmentary and may

[4] "Report of the California Earthquake Commission," Vol. I., Part II., pp. 220–45, and atlas, maps 17–19.

omit more than it includes. For the California district eleven are listed, within the same period, the record being somewhat vague, and possibly incomplete, for the first half of the century. To these we may tentatively add the Oregon or Klamath earthquake of 1867 and the Sonora and Arizona earthquake of 1887, raising the number to thirteen. In other parts of the United States were the New Madrid (1811–12), the Charleston (1886), and a relatively weak but probably destructive shock in the New Madrid region in 1865.

The average interval between the individuals of the California series was nine years, and the separate intervals, in order, were: 12, 24, 3, 18, 8, 2, 1, 4, 15, 5, 6 and 8 years. As the centers of disturbance were scattered through the whole district and the areas of dangerous violence were of moderate dimensions, the danger record for any single locality was smaller, and the intervals correspondingly larger. In San Francisco, for instance, the last five destructive shocks have been separated by intervals of 26, 3, 30 and 8 years.

While it is manifest at once that neither of these sequences constitutes a rhythm, it is quite conceivable that they represent in some way a system of rhythms. They might, for example, be composed of several independent rhythms, each beating with its own period; or they might contain imperfectly recorded rhythms, each requiring for its interpretation some of the less violent shocks not included in the destructive class. And if it were possible to group the shocks according to place of origin, it might be found that each earthquake center has its orderly law of sequence. But while the existence of such a systematic arrangement seems within the range of possibility, I regard it as altogether outside the field of probability; and I feel sure that any attempt to discriminate rhythmic series on numerical grounds, without any other basis for classification, would prove unprofitable.

The single element of order which unquestionably belongs to the sequence of quakings is implied by the term after-shock. Every great shock is followed by a train of minor shocks, the length of the train being roughly proportional to the magnitude of the initial shock, and the average strength and frequency of the shocks diminishing with the lapse of time. Usually also the great shock is preceded by faint tremors, or by a few small shocks. The prelude, the great shock and the train of after-shocks, together constitute a typical seismic event, and if their sequence could be absolutely depended on, the terror of the great shock might rationally be palliated by the thought that the worst is over. But unfortunately there are exceptions, and the character of the exceptions is not reassuring. Occasionally the prelude includes a shock of great power, and occasionally the train of after-shocks, instead of being wholly subordinate in intensity, includes one or more major shocks, rivaling the initial shock in violence. Of the twenty-five American examples fourteen were normal and two abnormal, the others remaining unclassified because too little is known of them. It is possibly significant that the two abnormal earthquakes were of exceptional power, the New Madrid heading the list for the United States, and the Yakutat, of Alaska, being of the same order of magnitude. The New Madrid event began with a shock of great violence at 2 o'clock on the morning of December 16, 1811, and this was followed by a long series of vigorous after-shocks, among which eight were noted as of special strength and three were reported as equalling or exceeding the initial shock. Of the last-mentioned, one followed the initial shock after an interval of five hours, and

the others severally after 38 and 53 days.[5] The Yakutat series began with a strong shock September 3, 1899, "and there were shocks at intervals until September 10, when, at 9:20 A.M., they began to be alarming. There were fifty-two shocks, culminating in one of great violence at 3 P.M. . . . There was another violent earthquake September 15 and other shocks until September 20."[6]

In view of these facts the promptings of terror when a great shock comes may well be seconded by the admonitions of wisdom, for even though it be probable that the worst is over, a substantial possibility remains that the worst is still to come. American experience suggests that as often as one time in eight a powerful shock, instead of being the climax of the earthquake, may be only the forerunner of the climax; and when life and limb are at stake the odds of seven to one in favor of safety form but a slender basis for mental serenity.

Turning now from the statistics of sequence to the question of underlying causes, I wish to present a conception of earthquake mechanism which has developed gradually during the study of California phenomena. The block movements associated with earthquakes in California are dominantly horizontal, and the fault planes along which the blocks slide are vertical. For this reason my mental picture of the system of faults (habitually drawn with two dimensions only) is a map instead of a section on a vertical plane. Imagine a large tract of the earth's crust superficially divided by faults into acute-angled blocks, which have a prevailing trend in one direction. In composition the blocks are heterogeneous, including stratified, metamorphic and igneous rocks, with complicated structure. The fault surfaces are not mathematically plane, but gently undulate, so that movement among the blocks involves more or less distortion of the blocks themselves. Imagine also that the tract is subject to external horizontal force of such nature as to induce internal shearing strains and the associated shearing stresses; and that the application of external force is continuous, making the internal stress cumulative. The internal stress is not uniformly distributed, because the more plastic rocks relieve the strain by flowage. When the stress along some part of a fault surface becomes greater than the adhesive force a slip occurs. When the stress within an elastic rock becomes greater than the shearing strength fracture takes place. In either case there is an instantaneous redistribution of stress. Relief of stress in the rock adjacent to the rupture is accompanied by increase of stress about the edges of the surface of parting, with the result that the area of the parting grows; and the growth is continued until regions of small stress are reached. The magnitude of the resulting earthquake depends chiefly on the quality of energy released by the relief of accumulated strain and stress.

If the quantities are large there are important after-effects. The discharge of strain causes a new arrangement of strains and stresses through a large tract; this leads to flowage and the local concentration of stress, especially in the more elastic rock; and this in turn causes fractures, of which the surface manifestations are after-shocks.

When finally equilibrium is restored, and the train of after-shocks is complete, the system of stresses, not only in the immediate neighborhood of the fault, but throughout an extensive tract, is mater-

[5] MS. of report on New Madrid earthquake by M. L. Fuller.

[6] "Recent Changes of Level in the Yakutat Bay Region," by R. S. Tarr and Lawrence Martin, *Bulletin Geol. Soc. Amer.*, Vol. XVII., p. 31.

ially different from what it was before the earthquake. In places, and especially near the fault, the general stress is less; in other places it is greater. The region of maximum stress is ordinarily shifted, so that when stresses imposed by external force again overtax the resistance, the new point of yielding is at some distance from the last.

In view of the complexity of the conditions and the intricacy of the interaction among strains, it is not to be supposed that the status at any one epoch will ever be exactly repeated. Nevertheless, its main features may recur, and whenever they do a cycle will have been completed. Such a cycle, however, would be indefinitely long, and would be too difficult of discovery to be available for purposes of forecast.

It is conceivable also that in some limited portions of the general district the local conditions may give rise to repetitive collapses somewhat independent of the general progress of events. In such case the successive earthquakes would originate in the same place and their systematic character could be recognized through that fact.

There is a class of natural and artificial rhythms in which energy gradually passes into the potential form as internal stress and strain and is thus stored until a resistance of fixed amount is overcome, when a catastrophic discharge of energy takes place. The supply of energy being continuous and uniform, the discharges recur with regular intervals. The frictional machine for generating electric sparks in the laboratory is the type; other examples are the geyser, water gurgling from a bottle, and the alternate adhesion and release of the violin bow in contact with the string. The earthquake is a repetitive catastrophe belonging to the same mechanical group, and if its mechanism were as simple as that of the electric machine its rhythm would be as perfect. If the stresses of an earthquake district affected only homogeneous rock and were always relieved by slipping on the same fault plane, the cycle of events would be regular; but with complexity of structure and multiplicity of alternative points of collapse, all superficial indication of rhythm is lost. If rhythmic order shall ever be found in the apparent confusion, it will be through an analysis which takes account of the points of origin of all important shocks.

Alternation.—The principle of alternation in the occurrence of earthquakes has already been touched. When a large amount of stored energy has been discharged in the production of a great earthquake and its after-shocks, it would seem theoretically that the next great seismic event in the same seismic district was more likely to occur at some other place, and that successive great events would be distributed with a sort of alternation through the district. This hypothesis I used twenty-five years ago, in predicting that the next slip on the fault at the base of the Wasatch range, instead of occurring in the locality of the last previous slip, would take place at a different point;[7] and it has been more recently applied by Omori, Hayes and Lawson in forecasting earthquakes on the western coast of the two Americas. These geographers agree in regarding the entire coast either as a single seismic district or as a portion of a greater district, in which there is interdependence of parts. Omori pointed out that in the period of six years from 1899 to 1905 there were extensive disturbances in Alaska, Mexico, Central America, Colombia and Ecuador; stated that the gap thus left between Alaska and Mexico had led him to anticipate an early

[7] Monograph I., U. S. Geological Survey, p. 362.

rupture in that tract of coast; and suggested, after his first anticipation had been realized by the San Francisco earthquake, that the next disturbance might be south of the equator—where the Valparaiso earthquake soon afterward occurred.[8]

Hayes, after the San Francisco and Valparaiso earthquakes, suggested Mexico as a probable locality for the next rupture; and after the earthquake which devastated the state of Guerrero in southern Mexico, made a similar suggestion as to Colombia.[9]

[8] In an interview published by the San Francisco *Bulletin* of June 13, 1906, F. Omori says: "Between 1899 and January 1 of this year (1906) there have been several extensive earthquakes along the coast of Alaska, Mexico, Central America, Colombia and Ecuador. These disturbances are not to be regarded as separate or unconnected phenomena, but were the result of great stress which was taking place all along the west coast of North and South America. The Pacific slope of the United States remained comparatively quiet all this time, so it was most natural to expect a continuation of the disturbance in these parts.

"As it has finally happened this time I believe it is over and the adjustment complete. . . .

"The center of a future earthquake, due perhaps to the same causes as this, will probably be different, and may take place as far away as the other side of the equator."

In a bulletin of the Imperial Earthquake Investigation Committee of Japan, published in January, 1907, Vol. I., pp. 21 and 23, he continues the subject, illustrating the distribution of seismic disturbances by a map, and concludes thus:

"The great stresses going on along the whole Pacific coast of America, which thus resulted in the occurrence of a series of great earthquakes, seem to be connected with the growth of the Rocky and Andes mountain ranges; the Valparaiso earthquake bringing probably the *great* seismic activity along the zone under consideration for the time to an end."

The forecast of an earthquake between Alaska and Mexico was verified by the California shock of 1906 and the forecast of a disturbance south of the equator by the Valparaiso earthquake of 1906. The forecast of immunity for some decades in the Mexico-Central America group was shown to be erroneous by the Mexican earthquake of 1907. The success or failure of the prediction of immunity for other parts of the coast remains to be determined. It is to be noted (1) that the Mexican earthquake, occurring in a district for which Omori predicted immunity, was forecast by both Hayes and Lawson; (2) that Lawson forecasts disturbance in a region north of California for which Omori forecasts immunity, and that Hayes forecasts disturbance for a region south of Mexico for which Omori forecasts immunity. See the following notes.

[9] C. W. Hayes is thus reported in the Washington *Times* of April 16, 1907:

"At least one man, who has studied seismic disturbances, has succeeded in predicting the locality of an earthquake months before the shock occurred.

"He is Dr. Charles Willard Hayes, of the United States Geological Survey, who made a report for the government on seismic conditions in Nicaragua in 1899. In this report he made the statement after the recent destructive earthquake at Valparaiso that he would not be surprised if the next section of the American continent to be visited by a seismic disturbance would be somewhere between San Francisco and Valparaiso, probably in Mexico.

"Dr. Hayes would not be surprised if the next earthquake should occur in the United States of Colombia, South America.

"In speaking of the earthquake in Mexico yesterday Dr. Hayes said to a *Times* reporter this morning:

"'While it is impossible to predict with any accuracy the location and time of the occurrence of an earthquake, our knowledge of the geological structure of the earth enables us to determine within certain limits the probable areas where seismic disturbances are most likely to occur. The course of these disturbances may be expected to follow a general line of adjustment of the earth's crust along the western slope of the two American continents, the line being somewhat broken in Central America.

"'The course from South America extends north to the islands in the Caribbean Sea, and that from North America is traceable down through Mexico and Central America. This course extends north along the coast of Alaska across the Aleutian Islands, down the Siberian coast, through Japan and thence across the Indian Ocean.

"'The disturbance in Alaska a few years ago was the first of the series that has afflicted the western hemisphere recently. It was natural to

Lawson mentioned breaks in the continuity of recent demonstrations, between the southern part of California and Central America, and between the northern part of California and Alaska, and suggested the probability of early visitations in Mexico and the Oregon-Washington region. In this forecast he anticipated by a few weeks the Guerrero earthquake.[10] Omori went farther and expressed the opinion that the Valparaiso earthquake was the final term of a series, and that the whole Pacific coast of America would be exempt for a time from *great* seismic activity. He expected for San Francisco a period of immunity of thirty to fifty years and for coastal regions from Alaska to Ecuador of twenty to thirty years.

It will be observed that this idea of a series, breaking on the American coast in the course of a few years, and followed by a comparatively long interval before the arrival of another series, an idea apparently shared by Hayes and Lawson, combines rhythm with alternation in the theory of forecasting.

Prediction and verification are the test of hypothesis, and this group of predictions—albeit tentative and advanced with judicious caution—embodying, as they do, the diverse views of independent investigators, who approach the subject from both seismologic and geologic sides, constitute a valuable contribution to seismic forecasting. The outcome in verification will have bearing not only on theories of alternation, rhythm and rhythmic immunity, but on the order of magnitude of the seismic district within which effective mechanical interaction takes place, and also on the profounder earth problems with which the question of the ultimate cause or causes of earthquakes is involved. If it shall appear as highly probable that yieldings to crustal stress in remote parts of North America have a direct influence on the dates of similar events in South America, the primary sources of the stresses can hardly be of such local nature as the shifting of load through degradation and aggradation or the outward flow of continental excess of matter, but should be sought rather in forces tending to deform the planet as a whole.

Trigger.—The third general principle applicable to prediction is that of the trigger—or the principle involved in the parable of the last straw, which broke the camel's back. As the growing earth stress

expect the next one at some distance, and, as it happened, this occurred at San Francisco. Then the Valparaiso disturbance being so far to the south it was probable that the next shake would be somewhere between the two. The shock at Jamaica was probably connected with the Valparaiso earthquake, being in the same course with it. That in Mexico is more likely to be connected with the course of disturbance from Alaska down.'

"Dr. Hayes, when asked if he would venture to predict the locality in which the next earthquake might occur, said that he did not wish to go on record as making any prediction on a matter concerning which scientific knowledge was so limited, but was of opinion that it would not be unreasonable to look for one in northern South America in the United States of Colombia. Asked whether a disturbance there would be likely to affect the region of the Panama canal, he thought that Panama might feel tremors from a considerable shock, but that it was unlikely any damage would result."

[10] A. C. Lawson, in a lecture read to the National Geographic Society, March 29, 1907, attributed the California earthquake to a series of ruptures that had been traveling along the western coast of America. "So far it has occurred everywhere along the coast except in a stretch between the southern part of California and Central America and an area between the northern part of California and the southern part of Alaska. These stretches, I believe, will be visited before long and then the long line of this earthquake will be complete from Chili to Alaska." This statement preceded by a few weeks the occurrence of the Guerrero earthquake in Mexico, and its prognostication was thus promptly verified as to the district south of California. It awaits verification for the district north of California.

little by little approaches the limit of the resisting force there is a critical period during which a relatively small additional stress arising from some other source may precipitate the catastrophe. A number of possible sources for the additional stress are known, the influence of several has been fairly demonstrated in a statistical way, and it is on the whole probable that a large majority of earthquakes owe their precise dates to such contributory causes. Many of the precipitating factors are periodic in their character, and the times of their maxima, or other favorable phases, are known; so that, granting their influence, they serve to restrict prediction to certain epochs. They are not of primary importance in forecasting, but when the approximate date of a future earthquake shall have been learned by other means, they will serve to refine the estimate of time.

The principal known causes of periodic variation of stress are bodily tides of the earth; oceanic tides, which alternately load and unload the sea bed near the shore; the winter load of snow on parts of the land; annual and diurnal variations of atmospheric pressure; diurnal variations of barometric gradient; and the wandering of the earth's axis of rotation. The relative importance of the several influences can not yet be indicated, but it is known that their absolute importance is not the same in all places. Three belong to the coastal belts, two to the land; and two belong to land and sea, but vary with latitude. Their relative importance in any particular locality may depend also on the direction of the slowly growing tectonic stress of the crust; for in order to be effective the temporary or adventitious stresses must be of such character as to augment the tectonic stresses. Let me illustrate this point.

The tidal sway of an oceanic basin raises and lowers the surface very little where the water is deep, but has a much greater effect on the shoals bordering coasts. The strip of sea bed following the coast is subjected twice a day to the addition of a heavy load of water, and in the intervening hours is relieved of pressure by the same amount. On the seaward side of the strip there is a gradual change in pressure, and on the landward side, just at the water edge, an abrupt change; and these pressure differences cause strains and stresses in the crust beneath. The directions of the induced strains lie in vertical planes at right angles to the coast, and are competent to increase or diminish tectonic stresses having similar directions. On the coast of Alaska near Mt. St. Elias the tectonic changes in progress include an uplift of mountains parallel to the coast, and the main tectonic stresses may be assumed to lie in vertical planes normal to the coast; so that here the oceanic tides are competent to precipitate earthquakes. But on the California coast near San Francisco, where the directions of the main tectonic stresses are horizontal and are approximately parallel to the coast, the stresses from oceanic tides may be ineffective. On the other hand the stresses created in the crust by the shifting of the axis of rotation are probably better calculated to augment tectonic stresses at San Francisco than at Mt. St. Elias.

Unfortunately the value to the forecaster of the periodic stresses is impaired by the occurrence of other transient stresses which are not periodic. The barometric gradients and extremes of pressure connected with cyclonic storms are of this class, and so are the pressure changes arising when the sea is pushed against the land or drawn from it by strong wind; and all these storm effects are at times much greater than the rhythmic changes of cor-

responding character. If storms are really earthquake-breeders—instead of the traditional calm, sultry, so-called "earthquake weather"—then the shocks they precipitate can be foretold only so long in advance as the storms themselves are foreknown.

The most potent of all precipitants of earthquakes is also useless to the forecaster because its action is unforeseen. It is the earthquake wave emanating from a nearby focus. The response to such an impulse follows the initial shock so closely that the two shocks are combined in a single seismic event—an earthquake with two foci, or a "double-earthquake."

Prelude.—The forecasting of earthquakes by means of prelude has nothing in common with other methods, but resembles rather the forecasting of the weather for the day by a glance at the sky in the morning. It depends on the recognition of premonitory signs, and also, to some extent, on the recognition of the earliest phases of the event itself.

When a fracture or other parting of the rock takes place, the jar which is communicated to surrounding portions of the crust is not a simple impulse, but a congeries of vibrations differing in amplitude and period, and in speed of transmission. At any point of the focus they begin together, but traveling through the rock at different rates, they arrive at any distant point at different times; and the greater the distance the greater their separation. The strongest of the vibrations, or those said to constitute the principal shock, are not the first to arrive, but are preceded by vibrations which are much weaker, and are known as the preliminary tremors. At a point twenty miles from the origin the preliminary tremors are felt four or five seconds before the principal shock. There are also vibrations too minute to be felt, and not yet recorded by the most delicate seismographs, but of such frequency that they fall within the register of the ear and are perceived as sounds, and these usually begin to arrive before the preliminary tremors. The sounds and faint tremors are notes of warning, and to him who not only hears and feels but understands they give command of precious seconds. People who live in earthquake countries and are familiar with these warnings acquire the habit of instantly taking precautionary measures.

Still earlier than the sounds and tremors with which the earthquake begins, are sometimes sounds, tremors or minor shocks, and it is suspected that phenomena of this sort may betray growing seismic activity and thus constitute premonitory symptoms of the final rupture. Little is known of them in any exact way, because they occur at a time when attention is not directed to such matters; and nearly all records are made from memory after the occurrence of the earthquake. If they are veritable preludes, connected in a systematic way with the mechanics of the earthquake, they are probably analogous to the cracklings and crepitations observed in strained beams and strained blocks of rock before collapse occurs. With reference to the possibilities of forecasting, expectation centers especially on faint tremors such as are occasionally perceived a few minutes or a few hours before an earthquake shock. They are more frequently inferred from the peculiar behavior of animals; and after making much allowance for the influence of imagination on the memory of observers, there is still reason to think that various animals are affected by vibrations to which man is insensible, and that their reported uneasiness before earthquake shocks is real and is occasioned by premonitory vibrations.

The scientific study of preludes belongs

to the future, and especially to such adaptations of seismographic appliances and methods as we may confidently anticipate. Feeble tremors, ascribed to minute crepitations of the crust, have already been made audible by means of the microphone, so that the ear could be applied to a sort of seismic stethoscope; and the next step will perhaps be to construct a seismograph of such delicacy as to record these minute vibrations, and install it where it will be undisturbed by tremors of artificial origin.

RÉSUMÉ

Summarizing briefly, many of the malloseismic districts or areas of earthquake danger are known from records of past experience, and others are being recognized by physiographic characters. Within them are tracts of special instability because of the incoherence of the underlying formation, and these can be both characterized in general terms and locally mapped. The general relations of danger to place are so well understood that an early solution of their outstanding problems may be assumed. Of the relations of danger to time much less is known and there is less promise for the immediate future. The hypothesis of rhythmic recurrence has no sure support from observation, and is not in working order for either large or small areas. Its corollary of local immunity after local disaster is more alluring than safe. The allied hypothesis of alternation between parts of a district is being tested by a great example, but the verdict belongs to the future. The hypothesis of precipitation by accessory forces which are in large part periodic and foreknown, has a good status and is being developed on the statistical side. It promises to make the date of prediction more precise if ever the approximate time shall be achieved by other means. The hypothesis of an intelligible prelude has barely been broached and the means to test it are not yet in sight. In a word the determination of danger districts and danger spots belongs to the past, the present and the near future; the determination of times of danger belongs to the indefinite future. The one lies largely within the domain of accomplishment; the other still lingers in that of endeavor and hope.

We may congratulate ourselves that it is not the place factor which lags behind, for knowledge of place has far more practical value than knowledge of time. In fact I see little practical value in any quality of time precision attainable along lines of achievement now seen to be open. Suppose, for example, that a prediction based on rhythm or alternation should indicate an earthquake as due in a certain year, and that tides should be recognized as the most potent accessory cause; then for several days each month, and possibly for many months, expectation would be tense, and the cost in anticipatory terror would be great. Or suppose that prelude phenomena should be found to afford real warning; the forecaster on duty would still have to deal in probabilities, and when in doubt would often sound vain warnings, in the conscientious effort to escape the greater error of omission at the critical time—and again nervous strain would be wasted. And even if warning were definite, timely and infallible, so that peril of life could be altogether avoided, property peril would still remain unless construction had been earthquake-proof. If, on the other hand, the places of peril are definitely known, even though the dates are indefinite, wise construction will take all necessary precautions, and the earthquake-proof house not only will insure itself but will practically insure its inmates.

MORAL

It remains to draw the moral. In view of these facts as to forecasting, and of the further fact that we have in our land a district subject to strong earthquakes, there are duties to be recognized and policies to be advocated. It is the duty of investigators—of seismologists, geologists and scientific engineers—to develop the theory of local danger spots, to discover the foci of recurrent shocks, to develop the theory of earthquake-proof construction. It is the duty of engineers and architects so to adjust construction to the character of the ground that safety shall be secured. It should be the policy of communities in the earthquake district to recognize the danger and make provision against it.

The general fact of local danger spots, where the agitation during strong earthquakes is peculiarly violent, has long been familiar. It is known that they are commonly found in lowlands where the underlying formation is a deep deposit of alluvium or other unconsolidated material, and that such material, while it aggravates great shocks, absorbs and quenches small ones. It is also known that the local phenomena are in some way connected with the transformation of earthquake waves in passing from elastic to inelastic material. But a mechanical theory of the phenomena is yet to be supplied. For economic, as well as scientific purposes, this is one of the important fields for investigation. In Japan, where earthquakes are much more frequent than in any portion of our own land, the subject has been studied and may still advantageously be studied, by the observation of natural shocks. In America the problem can be more readily studied by means of artificial earthquakes in the laboratory, continuing the line of experimentation begun by Rogers.[11] When the underlying principles have become known, it will be comparatively easy for geologists, engineers and architects to estimate the danger factor in places to be occupied by buildings.

The San Andreas rift,[12] now traced through so much of its length as traverses inhabited areas, is recognized as a danger belt of a peculiar character, to be avoided especially by water conduits and railways. Although it is probably the most extensive rift belt in the country, it is not the only one, and the positions of all others should be determined and mapped. The foci or epicenters of recurrent earthquakes are also localities of special danger, even though the underlying formation is firm and elastic. So far as the earthquake faults reach the surface of the ground, the epicentral tracts coincide with the rift belts and fault scarps; but some of the foci are doubtless wholly subterranean and need for their discovery a seismic survey like those conducted in Japan, Italy, England and, since the Valparaiso earthquake, in Chili. In Japan, which now takes first place in the study of earthquakes, the survey is conducted by a system of seismographic observatories in cooperation with a large body of local correspondents—a mode of organization quite analogous to that of our Weather Bureau, with its system of thoroughly equipped stations and its wide-spread corps of volunteer observers.

Much progress has already been made

[11] Professor F. J. Rogers, of Stanford University, gave harmonic motion in a horizontal direction to a box of sand, and found that under certain conditions a body resting on the sand received motion which was not harmonic, and which had greater amplitude and a much greater maximum acceleration than the motion of the box. His experiments are described in the "Report of the California Earthquake Commission," Vol. I., Part II., pp. 326–35.

[12] "The California Earthquake Investigation Commission," Vol. I., Part II., pp. 25–53.

in determining the principles of earthquake-proof construction. After each great earthquake which in modern times has devastated a city, there has been engineering study of the buildings which successfully resisted the vibrations and of those which succumbed, so that the construction of the future might profit by the experience of the past. In various countries, and especially in Japan, there have been series of experiments either for determining the mechanical character of earthquake shocks, or for testing the ability of different types of construction to withstand them. The results of these observations and experiments have helped to determine the building regulations and building methods in various earthquake districts. For our own purposes there are needed, not merely a complication of the principles developed elsewhere and of the deductions from recent experience in California, but special lines of investigation, covering, theoretically and experimentally, the materials and architectural methods employed in this country at the present time. In the line of experiment, we may well follow the example of our oriental neighbors, by constructing a machine which will give to a platform all the motions characteristic of a violent earthquake, and using the platform as a testing ground for types and materials of construction.

The proposition that it should be the policy of the inhabitants of an earthquake district to recognize the danger and make provision for it appears self-evident, but I regret to say that its soundness is not universally recognized in California. As long ago as 1868, Whitney, speaking of the Pacific states, said:

> The prevailing tone in that region, at present, is that of assumed indifference to the dangers of earthquake calamities—the author of a voluminous work on California, recently published in San Francisco, even going so far as to speak of earthquakes as "harmless disturbances." But earthquakes are not to be bluffed off. They will come, and will do a great deal of damage. The question is, How far can science mitigate the attendant evils, and thus do something toward giving that feeling of security which is necessary for the full development of that part of the country.[13]

This policy of assumed indifference, which is probably not shared by any other earthquake district in the world, has continued to the present time and is accompanied by a policy of concealment. It is feared that if the ground of California has a reputation for instability, the flow of immigration will be checked, capital will go elsewhere, and business activity will be impaired. Under the influence of this fear, a scientific report on the earthquake of 1868 was suppressed.[14] When the organization of the Seismological Society was under consideration, there were business men who discouraged the idea, because it would give undesirable publicity to the subject of earthquakes. Pains are taken to speak of the disaster of 1906 as a conflagration, and so far as possible the fact is ignored that the conflagration was caused, and its extinguishment prevented, by injuries due to the earthquake. During the period of after-shocks, it was the common practise of the San Francisco dailies to publish telegraphic accounts of small tremors perceived in the eastern part of the United States, but omit mention of stronger shocks in the city itself; and I was soberly informed by a resident of the city that the greater number of the shocks at that time were occasioned by explosions of dynamite in the neighborhood. The desire to ignore the earthquake danger has not altogether prevented the legitimate influence of the catastrophe on building regulations and building practises, but

[13] "Earthquakes," by J. D. Whitney, *North American Review* for April, 1869, Vol. CVIII., p. 608.

[14] "California State Earthquake Investigation Commission," Vol. I., Part II., p. 434.

there can be little question that it has encouraged unwise construction, not only in San Francisco but in other parts of the malloseismic district.

The policy of concealment is vain, because it does not conceal. It reflects a standard of commercial morality which is being rapidly superseded, for the successful salesman to-day is he who represents his goods fairly and frankly. It is unprofitable, because it interferes with measures of protection against a danger which is real and important.

To understand the practical importance of the earthquake danger, let us for a moment consider it from the insurance point of view. To determine rate of premium, an insurance company first computes the risk, and this computation is based on past experience, comparing the actual losses with the amount exposed to loss. We know, with fair approximation, the loss of life by earthquake in California from the year 1800, and can compare it with the population. As to the property loss, our knowledge is relatively indefinite, but it suffices for the present purpose.

Consider first the value of insurance against the danger of death by earthquake. Seven hundred and nine deaths are reported to have been caused by the San Francisco earthquake, and about 76 deaths by earlier earthquakes, making a total of 785.[15] The total annual population for the same period, that is to say, the sum of the populations for the several years, was about 51,500,000.[16] Using these data, the annual premium on a policy for $1,000, payable only in the event of death by earthquake, is computed at one cent and a half, plus the cost of doing the business and the profit of the company. The minuteness of the earthquake risk may be further indicated by saying that it is one tenth of the risk of death by measles. If a timid citizen of California should emigrate in order to escape the peril from earthquake, he would incur, during his journey, a peril at least two hundred times as great, whether he traveled by steamship, sailing vessel, railway car, motor car, stage, private carriage, or saddle; and if in emigrating he removed from San Francisco to Washington City he would incur, by change in environment as regards typhoid fever, an increment of peril eighteen times as great as the earthquake peril he escaped.[17]

The danger to property is much more serious. Using the same method of computation as before, and availing myself of the expert knowledge of local statisticians, I have made a parallel estimate of the earthquake risk to buildings in California, and find it to be about five hundred times as great as the risk to life. If a company were to undertake the insurance of buildings against injury by earthquake, and base its premium on the experience of the state from 1800 to 1908, the average premium on a policy of $1,000 would be about $7, plus the cost of doing the busi-

[15] The casualties in 1906 are given as reported by the State Board of Health; those in earlier years were compiled from Holden's "Catalogue of Earthquakes on the Pacific Coast, 1769 to 1897."

[16] To obtain this figure the populations of the state on census years were platted on section paper and a curve of population drawn through them, thus graphically interpolating estimates for intervening years. For years earlier than 1850 estimates were based on data contained in Hittell's "History of California." The census returns do not include Indians. In making estimates of the population previous to 1850 the Mission Indians were included. The estimate includes the year 1908.

[17] The U. S. Census returns for the years 1901–5 give the following death rates, per 100,000, from typhoid: San Francisco, 27.0; Washington, 56.6. The statement in the text of course applies only to the risk of death from typhoid; the death rate from *all* causes was higher, in the same years, in the western city than the eastern.

ness.[18] This is nearly twice as large as a similar figure expressing the fire risk for the United States, as based on the accumulated experience of underwriters. Just as in the case of fire insurance, the premium on earthquake insurance would be adjusted to the local conditions; it would be higher for houses on soft ground than for those on bed rock, relatively high for houses near known earthquake foci, and very low for houses classed as earthquake-proof.

In making this estimate the fire damage occasioned by the earthquake damage of 1906 was treated as part of the earthquake damage. Had the direct earthquake damage alone been considered, the computation would have yielded a figure materially smaller, though still comparable with the basal fire insurance factor. But there seems no good reason for excluding the fire damage, for not only was the San Francisco conflagration caused wholly by the earthquake, but fire is a frequent sequel of the wrecking of buildings by seismic shocks. Nearly all our appliances for heating, cooking and lighting are sources of fire danger when deranged by violence to the containing buildings, and if the agent of violence affects a large area, as in the case of earthquakes, the appliances for extinguishing fires are apt to be disabled at the same time.

It is possible that the estimate of the building risk is exaggerated by reason of its having been made just after the great disaster of 1906. It certainly would have been materially smaller if made by the same method just before that disaster. But this qualifying circumstance is largely if not wholly offset by the fact that various shocks of the same physical rank as that of 1906 wrought comparatively little havoc because at the time of their occurrence the areas shaken were sparsely populated—at least by house-building races. The Inyo earthquake of 1872, having its origin in Owens Valley, demolished the village of Lone Pine with a completeness not paralleled in 1906, and the falling walls crushed to death a tenth part of the village population. The shocks of 1812, affecting a tract on which Los Angeles, Santa Barbara and other large towns are now built, were limited in their destructive effect to the Spanish Missions because those were then the only houses; but the mission buildings fared badly, and it is related that thirty or forty mission Indians lost their lives. The earthquake hazard indicated by these occurrences was certainly not less than that emphasized by the recent disaster in a populous district,

[18] In assembling data for this estimate I was greatly assisted by Professors C. C. Plehn and A. W. Whitney, of the University of California, but these gentlemen are not to be held responsible for the estimate itself. The estimate involves, among others, the following assumptions: (1) in that part of San Francisco burned over in April, 1906, the loss from destruction and injury of buildings amounted to one third the entire loss; (2) the ratio of sound value to assessed value of buildings in San Francisco in 1905 was 1.7; (3) the similar ratio for the entire state was 2.0; (4) the average value of buildings per capita in California was the same for the entire period 1800–1908 as for the single year 1905. Some of the elements of the estimate are as follows:

Damage to buildings in burned district of San Francisco in 1906 (= ⅓ × $350,000,000)	$117,000,000
Damage to buildings in San Francisco, outside burned district, 1906	7,000,000
Damage to buildings outside of San Francisco, 1906	15,000,000
Damage to buildings in California, 1800–1905	20,000,000
Total earthquake damage to buildings in California, 1800–1908	$159,000,000
Total corresponding "exposure" (= sum of annual value of buildings in California 1800–1908)	$22,000,000,000
Basal insurance factor (= ratio of total loss to total exposure)	0.00723
Risk on policy of $1,000	$7.23

and yet the absolute losses they occasioned were so small as to have little influence on the totals used in the computation.

On the whole, weighing these and other factors of the problem as well as I am able, I am disposed to adhere to the estimate, not, indeed, claiming for it a high measure of precision, but regarding it as a fair approximation to the truth, and possibly as good as may be derived from the available facts.

It is needless to carry further the discussion of insurance rates. Its purpose has been served in showing that the earthquake risk to buildings in California is comparable with the fire risk and equally worthy of serious consideration. There is no present question of earthquake insurance, of which the function would be merely to distribute earthquake losses, but there is a question of the prevention of earthquake damage.

Earthquake damage is at least as preventable as fire damage. It is possible so to construct houses that they will neither collapse nor otherwise be vitally injured by such shocks as have visited California in the past. In a house so built there will be small danger from earthquake-started fires because they will be both accessible and quickly detected. It is wreckage that prevents the prompt extinguishment of the initial blaze. In a house so built there will be little damage to furniture, merchandise and other valuable contents. With houses so built the life risk will become a vanishing quantity, for practically all earthquake casualties are directly due to the failure of buildings. And in a community thus protected in life and property the terror of the mysterious unheralded temblor—a factor far outweighing the actual personal peril—will gradually wear away.

In saying that earthquake damage is preventable I would not be understood to imply that the subject of earthquake-proof construction is at all adequately developed. Competent modes of construction are known, but the best modes, the most economic modes, the modes best adapted to American materials and conditions remain to be determined, and there is much need of investigation.

It should be the policy of the people and state of California to see that the necessary investigations are made, and that the results are embodied in the building regulations of all cities as well as in the entire building practise of the state. And, in order that the methods of construction may be properly adjusted to the very unequal local requirements, provision should be made for a seismic survey and the mapping of tracts of special earthquake danger.

G. K. Gilbert

JEAN ALBERT GAUDRY[1]

From time to time as honored chieftains fall in the front ranks of the world's intellectual forces that are making for scientific progress, and bent on the conquest of new realms of knowledge, it befits men of a younger generation to take note of the passing of these heroes, these veteran standard-bearers who now rest from their labors, leaving a splendid memorial of their lifework behind them. Upon such occasions it is well to call to mind some of the more notable achievements of these patient searchers after truth, and to bethink ourselves what manner of men were they who contributed largely to widening the bounds of human understanding, whose lives were consecrated to the service of the sovereign mistress of truth.

An occasion of this kind has recently befallen us. Geological and biological science mourn the loss of Professor Albert Gaudry, foremost of the modern school of French paleontologists, a man of remarkable and versatile talents, in-

[1] Presented before the American Society of Vertebrate Paleontologists at the Baltimore meeting, December 30, 1908.

vestigator, teacher and author of far-reaching influence, and not less distinguished as a naturalist than universally beloved for his sweet simplicity of character and attractive personality. In him were happily combined that temper of mind and delicate sensitive spirit which proclaimed him not only as a fine type of the cultured scientific gentleman, but revealed him likewise as an *homme de cœur,* rich in human sympathy. Greatly as we deplore his loss, we may be glad that such a shining exemplar has graced our science. It is pleasing to contemplate him as a naturalist and interpreter of nature, but better still as a humanist. We honor him for his devoted service, we revere him for the lofty ideals he realized as a man. Much is expressed in the title by which his pupils and colleagues scattered over two continents were wont to address him: *maître vénéré.* His predominant trait was rightly characterized in an address delivered by his successor in the museum, Professor Boule, on a memorable occasion in the spring of 1903: "L'essence de votre nature, cher maître, c'est la bonté même." All who have enjoyed the privilege of personal acquaintance with the late president of the institute will concur in that sentiment.

The main facts in the life history of Professor Gaudry are briefly told. Born at Saint-Germain-en-Laye, near Paris in 1827, eldest son of a well-known advocate, as a youth fond of natural history pursuits and amateur collector of fossils at Montmartre, awarded the degree of doctor of science at the age of twenty-five and appointed assistant professor of paleontology at the Paris Museum the following year, we find him undertaking his first serious work as a naturalist whilst engaged on a scientific mission to the Orient and islands of the Ægean in 1853. His first publications date from the same year, and at this time he began his long-continued and classic studies of the late Tertiary vertebrate fauna at Pikermi in Attica. The results of this work, published 1862–7, under the title of "Animaux fossiles et géologie de l'Attique," together with its sequel on fossil vertebrates from Mont Léberon, won for him recognition as a leader in his special field, and constitute probably his most enduring monument in the province of descriptive paleontology. Other technical memoirs followed, among which it will suffice to mention those on *Actinodon* (1887), *Dryopithecus* (1890), pythonomorphs (1892) and Patagonian vertebrates, the last subject being one upon which he was still engaged at the time of his death, on the twenty-seventh day of November, 1908.

Excellent as are these special monographs, it is through his more popular, or at any rate less strictly technical, or perhaps we should say more broadly philosophical, writings, that Gaudry's name is most widely known both among his own countrymen and abroad. These brilliantly written essays, published in tripartite series during the years 1878–96, the first having for title "Les Enchaînements du monde animal," have exercised an incalculable influence in spreading evolutionary ideas and inculcating sound notions of paleozoology. It has been said that a philosopher is always something of a "poète manqué." This quality on the part of the author is strongly marked in the three volumes in question, and manifests itself not only in style, but in ideas, not only in the main theme under discussion, but in many a charming and naïve excursus, the effect of which is to make his work most exhilarating reading. His object is to present, as he tells us in one place, some things to instruct the mind, and yet others to satisfy the soul. And we must admit that he succeeds very well in both these aims. He was artist to this extent at least, that he sought in nature an ideal standard of truth and beauty, and made that standard effective in all human relations.

To the typical French mind, as to the ancient Greek, is commonly attributed a quick and accurate intuition, facile power of generalization, and a fondness for broad, comprehensive views as applied to any subject. Professor Gaudry well exemplified these racial characteristics. An analyst so far as involves the merely mechanical collection of facts, his genius consists in synthesis, in the rational coordination of his material after it has been laboriously brought together. In the early days of evolutionary discussion he incurred

reproach for being a *too* brilliant theorist. Time has since justified his keen sense of discrimination, his rigid intellectual candor, and subtlety in drawing right conclusions, not only in those momentous issues, but in most of his later philosophical writings. His work obviously has enduring qualities; his positive results are gained for all time, and become the heritage of science.

One further feature deserves to be pointed out. Professor Gaudry was always consistently opposed to the idea of following a scientific pursuit from primarily mercenary motives. He warns young men of the necessity of cultivating higher ideals of their chosen calling. His words seem to reecho those of Francis Bacon, who long ago complained that "men have entered into a desire of learning and knowledge, sometimes as if there were sought in knowledge a shop for profit and sale; and not a rich storehouse for the glory of the Creator and the relief of man's estate." On the other hand, his career reminds us more emphatically than any precept, that in order to attain the repose and exaltation of soul that come after a lifetime of worthy effort and resources nobly expended—"it is worth while in the days of our youth to strive hard for this great discipline; to pass sleepless nights for it, to give up to it laborious days; to spurn for it present pleasures; to endure for it afflicting poverty; to wade for it through darkness, and sorrow, and contempt, as the great spirits of the world have done in all ages and all times."

Finally, no truer thing could be said of Gaudry than one of the most graceful and talented of French writers—Flaubert—said of himself: "Je fais tout ce que je peux pour élargir continuellement ma cervelle et je travaille dans la sincérité de mon cœur; le reste ne dépend pas de moi."

C. R. Eastman

Harvard University

SCIENTIFIC NOTES AND NEWS

Mr. Alexander Agassiz and Professor Theobald Smith have been appointed delegates from Harvard University to the Darwin Celebration at Cambridge University, England, in June, 1909.

The Académie Royale de Médecine de Belgique, at its meeting of December 26, last, elected Dr. Charles S. Minot, of the Harvard Medical School, a foreign corresponding member of the academy.

M. P. Villard has been elected to succeed M. Mascart as a member of the Paris Academy of Sciences, in the section of physics.

Dr. Henry E. Crampton has been appointed curator of the department of invertebrate zoology in the American Museum of Natural History, to fill the place made vacant by the resignation of Dr. William M. Wheeler. He will retain an official connection with Columbia University, where he now is professor of zoology in Barnard College. Dr. Frank E. Lutz, investigator in the Station for Experimental Evolution of the Carnegie Institution, has been appointed an assistant curator in the museum. Dr. Alexander Petrunkevitch has become officially connected with the museum as honorary curator of the Arachnida.

President Eliot has purchased a house on Brattle Street, Cambridge, which he will occupy after leaving the residence provided by Harvard University for the president.

Dr. H. C. Chapman, professor of the institutes of medicine and medical jurisprudence at Jefferson Medical College, and for thirty-two years a member of the faculty, has resigned, his resignation to take effect in May next.

Governor Guild, of Massachusetts, has been elected president of the American Forestry Association to succeed President Wilson.

Professor Robert Koch has been elected a president of the German Central Committee for the Prevention of Tuberculosis, in the room of its founder, the late Herr Friedrich Althoff, ministerial director of the Prussian Education Office.

Dr. and Mrs. W. A. Murrill are in Jamaica to study and collect fungi in the interests of the New York Botanical Garden.

PROFESSOR HIRAM BINGHAM, of Yale University, after attending the pan-American Scientific Congress that has just closed at Santiago, Chile, left for southern Peru, to engage in historical research.

LIEUTENANT BOYD ALEXANDER left England on December 12 with the object of thoroughly exploring the islands of São Thomé, Principe and Annobon, chiefly from a zoological point of view.

DR. SVEN HEDIN has visited Japan on his way home and has there received various honors, including the medal of the Japanese Geographical Society. Twenty-nine years ago the late Baron Nordenskiöld, after his accomplishment of the northeast passage, received from the society its medal, and a similar medal was afterwards awarded to General Fukoshima for his ride through Siberia. Dr. Hedin, it seems, is only the third who has received this medal, and the only two foreigners who have been awarded this honor are Swedes.

AT the meeting of the College of Physicians, Philadelphia, on January 6, the following officers were elected: *President*, Dr. James Tyson; *Vice-president*, Dr. G. E. de Schweinitz; *Censors*, Dr. Richard A. Cleeman, Dr. S. Weir Mitchell, Dr. Louis Starr and Dr. Arthur M. V. Meigs; *Secretary*, Dr. Thomas R. Neilson; *Treasurer*, Dr. Richard H. Harte.

AT the December meeting of the St. Louis Chemical Society, the following officers were elected for the ensuing year: *President*, H. E. Wiedemann; *Vice-president*, C. J. Borgmeyer; *Recording Secretary*, Geo. Lang, Jr.; *Corresponding Secretary*, J. J. Kessler; *Treasurer*, A. A. Kleinschmidt; *Councilors*, C. E. Caspari and Leo Suppan.

DR. HENRY PRENTISS ARMSBY, director of the Institute of Animal Nutrition of the Pennsylvania State College, delivered a course of four lectures on the Principles of Animal Nutrition at the New York State Agricultural College, at Cornell University on January 12–15.

ON February 27, Professor Charles E. Lucke, head of the department of mechanical engineering of the Schools of Mines, Engineering and Chemistry, of Columbia University, will speak on the general subject of "Gas Power" before the Society of Arts of the Massachusetts Institute of Technology.

PROFESSOR HARRY GOVIER SEELEY, at one time professor of geology and geography in King's College, London, author of numerous contributions to zoology and paleontology, especially on fossil reptiles, has died at the age of seventy years.

BY will of the late Professor Albert Gaudry, thrice president of the Société Géologique de France, that body receives a bequest of forty thousand francs, the income of which is to be applied in making suitable awards in recognition of meritorious work done in geology or paleontology, either by Frenchmen or foreigners. A portion of the fund may also be used in aiding deserving students in these branches.

THE late Professor Sacharjin has left two millions of roubles for the erection of a hospital in Moscow.

THE prize of the King of Belgium of the value of 25,000 francs will be awarded this year to the author of the best work on aerial navigation.

THE prize of five hundred dollars which is offered biennially by the Association of the Alumni of the College of Physicians and Surgeons, Columbia University, will be awarded in June, 1909. Essays in competition for the prize must be forwarded to Dr. H. E. Hale, 752 West End Avenue, New York, on or before the first of April.

IT is announced that the recent fire at the Geological Survey building on F Street in Washington destroyed property to the value of about $16,000. Ten thousand dollars' worth of surveying instruments were destroyed, and an expenditure of $2,000 will be necessarily incurred for rewiring the building. The offices of the survey, like those of many other government bureaus in Washington that occupy rented buildings, are full of wooden partitions and other inflammable material, exposing valuable public property to the danger of destruction by fire at any time.

IN view of the scientific interests of the volcanic formation within the Rio Grande and

Cochetopa national forests in Colorado, President Roosevelt has made them a reservation under the act for the preservation of American antiquities. The district will be known as the Wheeler National Monument.

AT the invitation of Mr. George Otis Smith an informal conference was held at the Cosmos Club, Washington, D. C., on January 2, 1909, for the purpose of discussing the progress of geologic work and with a view to bringing about a better coordination of the various investigations now being carried on. Professor T. C. Chamberlin presided at the meeting and of those invited to attend there were present: F. D. Adams, H. Foster Bain, Joseph Barrell, R. W. Brock, A. H. Brooks, Samuel Calvin, M. R. Campbell, T. C. Chamberlin, W. B. Clark, J. M. Clarke, Whitman Cross, H. P. Cushing, Arthur L. Day, B. K. Emerson, S. F. Emmons, N. M. Fenneman, H. E. Gregory, Arnold Hague, C. Willard Hayes, J. P. Iddings, Arthur Keith, H. B. Kummel, A. C. Lane, Waldemar Lindgren, A. P. Low, W. C. Mendenhall, H. F. Osborn, T. W. Stanton, C. R. Van Hise, A. C. Veatch, David White, H. S. Williams, Bailey Willis.

THE Sheffield lectures at Yale University will be given this year, with two exceptions, by members of the scientific school faculty, The lectures will be illustrated and will be delivered on Friday evenings as follows:

January 15—"Growth of the North American Continent during Geologic Times," by Professor Charles Schuchert.

January 22—"The American Gem Stones," by Professor William E. Ford, '99 S.

January 29—"Paper Making from Wood," by Dr. Arthur L. Dean, '02 Ph.D.

February 5—"Dinosaurs: their Evolution and Distribution," by Professor Richard S. Lull.

February 12—"The Modern Steel Bridge," by Professor John C. Tracy, '90 S.

February 19—"The Safety Devices of the Human Body," by Professor Lafayette B. Mendel, '91.

February 26—"Influence of Geology on the History of Jamaica," by Dr. Rossiter W. Raymond.

March 5—"Recent Discoveries in Electricity and some of their Consequences," by Professor Lynde P. Wheeler, '94 S.

March 12—"The Iron Resources of the United States: their Past and Future," by Professor John D. Irving.

March 19—"Land Reclamation in the United States: the Problems, the Opportunity," by Dr. George T. Surface.

A STATEMENT regarding the anthracite industry of Pennsylvania has been prepared by Wm. W. Ruley, chief of the Bureau of Anthracite Coal Statistics, of Philadelphia. Mr. Ruley estimates that the shipments of anthracite for 1908 were 64,237,076 long tons, against 67,109,393 long tons in 1907, indicating a decrease of 2,872,317 long tons, or 4.28 per cent. If the quantity of coal sold to the local trade and used at the mines decreased in the same proportion, the total production in 1908 amounted to approximately 73,200,000 long tons, as against 76,432,421 long tons in 1907. Reports received by Edward W. Parker, statistician, of the United States Geological Survey, from state officials and others closely in touch with the coal-mining industry in the several states indicate that the output of the bituminous coal mines of the country in 1908 was between 320,000,000 and 330,000,000 short tons. If the final returns are found to agree closely with these preliminary figures they will indicate a decrease in production of 15 to 20 per cent. as compared with the production in 1907.

THE Third Congress on School Hygiene will be held in Paris from March 29 to April 2, 1909. There will be an exhibition in connection with the congress. The congress held its first meeting at Nuremberg in 1904, and its second in London in 1907.

UNIVERSITY AND EDUCATIONAL NEWS

GIFTS to the amount of $346,466.05 were announced at the recent meeting of the trustees of Princeton University, of which the largest, $200,000, was that of Messrs. David B. Jones and Thomas D. Jones, of Chicago, for the Palmer Physical Laboratory endowment fund. Other gifts were $25,370 from the committee of fifty and $34,377.07 from the General Education Board.

MORE than $40,000 has been subscribed towards a fund of $100,000 to endow a chair of physiology at the University of Cincinnati, in honor of the late Joseph Eichberg.

IT is announced by President John Thomas, of Middlebury College, that $91,686.50 has been contributed toward the $100,000 needed to secure the D. K. Pearson building and endowment fund of $100,000.

BY the will of Dr. James G. Wheeler, Broughton, the James Millikin University, Decatur, will come into possession of his estate, estimated to be worth from $75,000 to $125,000.

THE Ohio State University has received a gift of $10,000 from Mr. Robert T. Scott, Cadiz, the income to be used for the aid of poor students.

THE medical department of the University of Pennsylvania, has concluded arrangements for holding the first annual "Home Coming, or Progressive Medicine Week," to be given for the benefit of the alumni of the school, and to occupy the Easter vacation period. Plans are being considered to have each head of a department arrange, with the cooperation of his assistants, a program which will note deviations from the old standards, as well as lay stress upon principles which by constant practise have become crystallized. The alumni of the medical school who have distinguished themselves in their profession will be invited to cooperate.

ABBOTT LAWRENCE LOWELL, since 1900 professor of the science of government in Harvard University and previously since his graduation from Harvard College and the Law School a lawyer practising in Boston, will succeed Mr. Eliot as president of Harvard University.

DR. CHARLES H. HASKINS, professor of history in Harvard University, has been appointed dean of the Graduate School of Arts and Sciences, to succeed the late Professor John Henry Wright.

DISCUSSION AND CORRESPONDENCE

PECULIAR ELECTRICAL PHENOMENA

IN an article by Professor J. E. Church, Jr., in SCIENCE, November 6, 1908, page 651, entitled "Electric Disturbances and Perils on Mountain Tops," Professor Church describes the peculiar brush discharges that emanated from the weather vane, the anemometer cups and other objects in an electric storm on Mount Rose, on October 20, 1907, between 6:30 and 7:30 P.M. He states also: "Whenever our hands arose in the air, every finger sent forth a vigorous flame."

It may be interesting to note that we find descriptions of similar phenomena in the Elizabethan era, and even in the days of Julius Cæsar. In the "Itinerary of Fynes Moryson" (Macmillan, 1908), Vol. 3, pp. 74–76, there is given an account of an electric storm on the night of December 23, 1601, at Kinsale, near Cork, Ireland. This storm, which took place in midwinter, and in a locality that was practically on the sea level, was preceded by "great lightning and terrible thunder" on the night of December 20, and by "continual flashes of lightning" on the night of December 21.

The following is Moryson's account:

> All the night was cleare [*i. e.*, brilliant?] with lightning (as in the former nights were great lightning with thunder) to the astonishment of many in respect of the season of the yeare. And I have heard by many horsemen of good credit, and namely by Captaine Pikeman, Cornet to the Lord Deputies troope, a Gentleman of good estimation in the Army, that this night our horsemen [who were] set to watch, to their seeming did see Lampes burne at the points of their staves or speares in the middest of these lightning flashes.

Again in North's "Plutarch," "Life of Julius Cæsar" as quoted in Porter and Clarke's edition of Julius Cæsar, p. 119:

> Strabo the Philosopher writeth that divers men were seene going up and down in fire; and furthermore, that there was a slave of the soldiers that did cast a marvellous burning flame out of his hand; insomuch as they that saw it thought he had been burnt, but when the fire was out it was found he had no hurt.

Shakespeare has embodied this account of Plutarch's in his tragedy of Julius Cæsar, Act I., Scene 3, lines 15–25. See also Burritt's "Geography of the Heavens," revised edition, New York, 1859, p. 155, for a reference to a somewhat similar phenomenon as observed by Baccaria.

HENRY PEMBERTON, JR.

RAILROAD RATES FOR THE BALTIMORE MEETING

To the Editor of Science: It has been the custom for many years past to obtain a railroad rate concession for the meeting of the American Association for the Advancement of Science and the affiliated societies. Formerly this was granted at one and one third—a rate, even at that time, far in excess of what could be obtained by a single professor who wished to conduct a handful of students on a geological excursion. To this rate was later added the twenty-five cents validation fee. Then came the concession of two cents per mile, for the Chicago meeting of 1907–8, a rate practically equivalent to the ordinary charges of the roads, to which must be added the validation fee. This year, the arrangements have been exceedingly liberal—one and three fifths plus the validation fee. Taking the rate from Philadelphia to Baltimore as an example: the one fare, $2.40, and the three fifths, $1.44, plus the validation fee, $0.25, amount to $4.09, a sum in excess of the regular round-trip fare of $4.00.

I am aware that for those attending the meeting from a long distance, the rate granted *may* mean a slight reduction, but, even the scientific world is not made up of altruists, and members from the nearer localities will not pay more for their tickets than the ordinary round-trip fare, and trouble themselves besides to obtain certificates, deposit them for validation, call for them, and re-sign for the return trip—four unnecessary wastings of time—for the sake of accommodating those from a longer distance, and there is thus a possibility that the certificates presented may fall short of the required number, with the result of adding greatly to the expenses of members from a distance who put faith in the certificate plan.

I do not know, nor care to know, who is responsible for this most remarkable rate, but I do know what has been done by private individuals, and I am convinced that, with an organization so numerically strong as the American Association for the Advancement of Science and the affiliated societies at its back, the committee, if it be indued with a real desire and determination to obtain concessions that are worth while, will never again offer to the most powerful scientific body of the United States, an illusory grant.

H. Newell Wardle

QUOTATIONS

HARVARD'S NEW PRESIDENT

It would appear that all the recognized demands, exacting though they are, have met satisfactory compliance in to-day's selection of a president of Harvard. Professor Lowell's attainments as a scholar, although well known for many years to the inner circle, have recently received new recognition, both in America and abroad. It is quite beyond question that his recent notable volumes on "The Government of England" have placed him first among contemporary American scholars in the field of political science. To his skill as an administrator the success of the Lowell Institute affords striking testimony, while his deep and active interest in educational questions has received proof in his effective service as a trustee of the Institute of Technology and as a member, for nine years past, of the Harvard faculty. He is a Bostonian by inheritance, by nativity, and by tradition. He is a Harvard man by education, both collegiate and professional; the university can claim no stancher allegiance than his has been. At fifty-two nature has permitted him to retain a nimbleness of mind and body which in the case of most men takes its departure at a much earlier age. Indeed, from every point of view his selection seems obvious, logical and fortunate.

The hand of the president is potent at Harvard; more so perhaps than in any sister institution. Harvard government is that of a limited monarchy, but with the right type of monarch the administration can be made to veer pretty close to the status of a benevolent despotism. To say that it has veered in this direction during the last two or three decades is the highest tribute one may pay to the consummate skill and personal power of President Eliot. But this very development, this centralization of power, influence and responsibility which the retiring Nestor among

college presidents has brought into being will serve to make his mantle fall heavily upon him who must now take it up. To bear it as it has been borne will prove no easy task.—*Boston Evening Transcript.*

SCIENTIFIC BOOKS

ELIOT AND THE AMERICAN UNIVERSITY[1]

FORTY years ago, there was chosen to the presidency of Harvard College, a young professor of chemistry, who had none of the qualities then commonly supposed to be necessary in the position which he held. He was not a clergyman, not a teacher of philosophy, not venerable and not spiritual, merely young, industrious, clear-sighted, scholarly and fearless. Harvard College was in those days only a small institution, chiefly for boys, "a respectable high school where they taught the dregs of learning," as its most popular teacher then described it. Still it was the best we had and our own "our oldest, richest and freest university," even as it is to-day.

In 1868, the young president found an institution of the old type, with some most charming and gifted professors, and others dry as dust. Its work was all elementary in character, the subjects taught were held to be of unequal value, the Greek and the Latin standing in official precedence. Of advanced study there was little, and that little existed in the unique personality of Louis Agassiz and of Asa Gray. It was essentially a boys' school, and a school of the type which forces set tasks on unwilling youth. One of the graduating class of 1873 said to the present writer, at the time that in his class there were but two men (J. W. Fewkes was the other) "who had any interest in natural history or in anything else." Doubtless this was an exaggerated statement, but it represented fairly the attitude of the college boy in those days of prescribed courses and text-book recitations in elementary subjects. In those days, too, the professional schools had no foundation in science or in culture, and the instruction given in them was guiltless of pedagogic methods or ideals. In almost all departments of Harvard College advanced education was a grind rewarded by a degree. The degree was a badge of social and intellectual achievement, not a disclosure of the secret of power.

To change all this was not an easy task, and the young president had grown middle-aged before the greater part of his work was achieved. He rightly interpreted his position as representing in no sense a fact accomplished. It was of necessity a continuous struggle; a struggle for greater means, for better men and for higher ideals. An American university is never finished.

Fortunately for himself and for the nation, Dr. Eliot has lived to wear out all opposition; he has seen Harvard College made over after his own fashion, and he has seen it lead the race in a long procession of institutions, one and all endeavoring to follow in its trail. The various impulses of originality in other institutions, notably those originating with Andrew D. White, at Cornell, and with Daniel C. Gilman, at Johns Hopkins, have been absorbed by Harvard, and in general carried to the greatest success yet possible under American conditions. To Cornell we owe originally the doctrine of the democracy of studies, the idea that no one shall say which subject or which discipline is best until we know the man on whom it is to be tried. To Johns Hopkins we owe the idea that advanced work in any subject has a greater culture value than elementary work in the same or other subjects. Both these doctrines have found their place in the elective system at Harvard.

In the lectures on university administration at Northwestern University, President Eliot explains in detail, in simple undramatic fashion, the plan of his work at Harvard, its methods and its results. That the most successful of college administrators should regard the methods which he has himself used as typical and desirable, is natural enough. If other methods had seemed better, he was perfectly free to use them. This volume is therefore an exposition of what Harvard actually is, and the reasons why it is so, in so far as these depend on administrative methods of

[1] "University Administration," by Charles W. Eliot, Boston, Houghton, Mifflin Co.

any sort. The book is the best of reading for college men, and to the college president it is a veritable hand-book full of suggestiveness on every page.

The board of university trustees at Harvard numbers seven, with the president of the university as the executive head. This number is most favorable to the management of business, and this relation the one most likely to insure devotion and continuity in executive affairs. The disadvantages of large boards, of honorary, ex-officio and absentee trustees, clearly appear in the light of Harvard's experience with a better way. The importance of beginning with young men appears here as elsewhere, and with this Dr. Eliot has the significant remark, "Strangers will, as a rule, not make so good trustees as the children of the house."

In the suggestions as to professors' salaries, Dr. Eliot is rather conservative, especially as regards the younger men, although the professor is better paid at Harvard at present than in any other American college or university. The instructor, he thinks, should begin on the amount a young unmarried man can manage to live on. After a few years of annual appointment, a permanent position with a small increment should be given, and still later, as assistant professor, he should receive a sum on which he may marry but without luxury or costly pleasures. At forty, if growth goes on, the teacher may hope for a professorship, and a full salary at fifty or fifty-five. One difficulty in all this comes from the fact that growth is largely conditional on travel, and travel is a "costly pleasure." To starve a man until he is forty is not to provide for a productive career for the fifteen years that follow.

In all financial matters, President Eliot has been preeminently practical, and the paragraphs relating to the business affairs of the college are thoroughly wise and pertinent. The exclusion of the college president from initial responsibility in these matters is a mistake, and one which has been adopted in too many of our institutions.

The coordination of the influence of the alumni, as represented by the board of overseers at Harvard, is a matter on which Dr. Eliot justly lays especial emphasis.

In the development of the faculty at Harvard, stress has been laid on the individual teacher rather than on the department. As a result of this the department or group executive appears rather as a servant or representative, than as a director or manager of his colleagues. The president stands in the same relation to all the various groups. The system, in vogue in many institutions, by which the professors are brought together into groups under the headship of some dean, who rules over them, the dean in turn ruled over by the president, has never taken root at Harvard. Deans, or sub-executives, are doubtless necessary in large institutions, but they should not be created until they are needed. Above all, what is needed by the executive in all branches is not so much authority to execute as the power and the duty to initiate. Nowhere is the necessity for the concentration of initiative so important as in the duty of the nomination of professors. President Eliot shows clearly the reasons why formal faculty initiative fails in this regard. But there are good reasons why formal faculty acceptance of such nominations is also most desirable. No professor should be added to the faculty against the sober judgment of those who may be his colleagues.

President Eliot devotes one optimistic chapter to the consideration of the greatest of his educational innovations, the elective system. This system has everywhere and of necessity replaced the classical system, which considered but two or three of the many phases of scholarship and life. For Greek-minded men, to use Emerson's phrase (and a very noble type of men they are) the classical training gave a basis of scholarship on which later studies could build to advantage. But the great body of our youth of promise are anything but Greek-minded, and the old classical course opened to them no door worth their entering. The elective system opens many doors and admits many types of men. No two men need exactly the same sort of training for their own best development. The student is a better judge of his own needs than

any group of educational philosophers who have never known him. Here, as elsewhere, the student learns from his own mistakes. Moreover, the elective system brings the student in contact with the best teachers he knows, and the teacher in turn is refined and stimulated by the students who have chosen his work. To the patchwork courses which followed the break-up of the classical system, the elective courses are in every way to be preferred. The mind is made strong by the continuous study of something, and in prescribed courses made up of odds and ends unrelated to any central purpose, thoroughness in any line is impossible. At the present time there is a distinct reaction against the elective system, but not in favor of any other system which has been actually under trial. The elective system will not make scholars out of rich and idle lads whose only interests in college are in games and social pleasures. Once in a while such a one is reclaimed, but the percentage is too small to justify the effort. The elective system is as good as any other system for such as these, but no system will make a man out of a boy who has himself no interest in the process. It is the duty of the college to withhold its degrees from idlers of whatever class. To give the titles of higher education where the substance is lacking is to cheapen our own work. The remedy for slipshod college work is found in the scholarship committee, rather than in the arrangement of courses of study. The final answer to criticisms of the elective system is to recognize its occasional abuses by professors as well as by students, and to ask, what else will you put in its place?

Doubtless a prescribed course is sometimes effective, as in engineering or in medicine, but only where it is prescribed by the nature of the subject. Mathematical subjects are linked together, one dependent on another, and the student desiring mathematics makes no complaint of this prescribed order. But for courses of mixed science, literature, art and philosophy, so many units of one, so many of another, disjointed fragments brought together in the name of culture, the student can have no respect. Required courses of this fashion have passed away never to return. The checks on the elective system must come from the student himself. He must be trained to guard himself from premature specialization on the one hand and from limp diffuseness on the other. If he is a real student, the safe mean leans strongly toward the side of specialization, for after all this is but another name for thoroughness. "The mind is made strong by the thorough possession of something."

The writer once heard President Eliot disclaim any unusual degree of prophetic vision, allowing for himself only an honest industry, attacking one problem as it arose after another, with such solution of each as might be within the range of practical action.

One of Dr. Eliot's predecessors in Harvard was once complimented on the logical coherence of his sermons. He disclaimed all special excellence in this regard. "I write one sentence," he said, "then I thank God and write another." President Eliot has himself accepted this definition of his method. One thing done, he turns to and does the next, and this is the essence of his educational foresight. He does the next and the next, never stopping with the first result or the first achievement; and thus he has made of the administration of Harvard a continuous struggle, while all our other colleges have followed near or far along the same lines of progress.

And to the young man on whom his mantle shall fall, the administration of Harvard will still be a struggle. Nothing is completed, nothing is settled, nothing is final. New lines of development will follow swiftly on the old. The university must be separated from the college, and must be devoted wholly to the work of men as distinguished from the work of boys. All trace of the trade school must be eliminated from the training of professional men. The university professor on the firing line of scientific advance must be maintained and appreciated and none the less the college teacher whose first aim shall be to develop the boy into the sound, sober and enlightened man. The unification of higher education has been in a degree accomplished.

The substantial requirements for entrance, the broad outlook of the elective system, the intensive thoroughness of the graduate professional school, the glorification of the spirit of research, all these are exemplified in the Harvard of to-day. The Harvard of to-morrow will lead in the differentiation of the work of men, the separation of boys and boys' teachers from men and men's teachers. It will not be Harvard College as it was, nor interchangeably Harvard College and Harvard University as it is to-day. It will be a university resting on a college foundation, a university worthy of the eighty millions of free men who form its constituency, a university fit to frame the highest aspirations of the noblest youth of the republic.

David Starr Jordan

SCIENTIFIC JOURNALS AND ARTICLES

It is ever a wonder to us in America that German biologists can so easily start and maintain a new periodical. No sooner does a science become well defined and gain a number of workers than the proper periodical is forthcoming. These remarks are called forth by the appearance of the *Internationale Revue der gesamten Hydrobiologie und Hydrographie* (Leipzig: Klinkhardt), of which the first (double) number appeared in May. The backing of the magazine is indicated by the names on the cover. R. Woltereck (of Leipzig and Lunz) is the editor. B. Helland-Hansen (Berlin), G. Karsten (Bonn), A. Penck (Berlin), C. Wesenberg-Lund (Hilleröd), R. and F. Zschokke (Basel) are the other members of the editorial staff. The Prince of Monaco, Agassiz, Chun, Forel, V. Hensen, R. Hertwig, Murray, Nansen, O. Pettersson and Weismann have lent their names to the undertaking. The first number contains 307 octavo pages, of which the first half contain original contributions; those of Weismann, Murray, R. Hertwig and Issel being essays written especially for the introduction of the new journal. A paper by Nathansohn begins a projected series on the biology of the plankton; one by A. Fischel deals with very successful intravitam staining of *Cladocera;* one by Klausener treats of the annual cycle of the fauna of alpine lakes; and one by Götziner in the first part of a monograph on Mitter Lake at Lunz, in the Austrian Alps. The remainder of the number contains abstracts of reports, summaries of results, critical reviews, notices from stations and a list of recent literature. There are eight plates and numerous text-figures. Certainly the periodical starts out with the highest ideals and it will be a great stimulus to hydrobiology. It deserves, as it will receive, the most active support of the numerous American workers in this field. C. B. D.

The Independent begins with its issue for January 7, 1909, a series of articles on the fourteen universities of this country, written by Dr. Edwin E. Slosson, of the editorial staff and previously professor of chemistry in the University of Wyoming. Harvard is the first institution discussed and the others to follow in the order named at intervals of one month are: Yale, Princeton, Pennsylvania, Chicago, Johns Hopkins, Stanford, California, Michigan, Wisconsin, Minnesota, Illinois, Cornell and Columbia.

BOTANICAL NOTES

TREES AND FORESTRY

The University of California has done well in publishing Mr. N. D. Ingham's bulletin (No. 196) on "Eucalyptus in California." In 88 pages the author by means of plain descriptions and 70 excellent half-tones gives his readers some very clear and usually very new ideas as to these wonderfully interesting trees as they grow in California.

Major George P. Ahern's "Annual Report of the Director of Forestry of the Philippine Islands," for the year ending June 30, 1907, is of interest to forestry students in this country as showing the considerably different problems which pertain to work in the islands. Two maps help to give a clearer idea as to the available forest tracts in Negros Occidental and Mindoro.

Two years ago Rolland Gardner, of the timber-testing laboratory at Manila, published a bulletin (No. 4) on the "Mechanical

Tests, Properties and Uses" of thirty-four Philippine woods, and a year later, the edition being exhausted, a second, revised edition was brought out. In its present form it includes a popular discussion of the qualities of woods and the meaning of timber tests, methods of testing and results of tests, structural qualities, appearance and uses. In the last-named section, in addition to common names the scientific names as far as they can be determined are given. An interesting comparison of the tests of Philippine and American woods shows that the former rank very high.

L. A. Dode's "Notes Dendrologiques" in the *Bulletin de la Société Dondrologique de France* (1907) includes notes on *Ailantus, Catalpa, Sorbus, Clerodendron* and *Platanus,* in most of which genera the author of course finds "new species"!

ANOTHER BOOK ON NORTH AMERICAN TREES

GEORGE B. SUDWORTH, dendrologist in the Forest Service, has made an important contribution to our knowledge of the trees of the western part of North America by the publication (October 1, 1908) of a thick pamphlet of 441 pages under the title "Forest Trees of the Pacific Slope." It is the first part of a work intended to deal with all the native forest trees of North America north of the Mexican boundary. This volume contains an account of the trees known to occur in Alaska, British Columbia, Washington, Oregon and California. Part II. will be devoted to the Rocky Mountain trees, part III. to the trees of the southern states, and part IV. to the trees of the northern states. The work when completed will therefore be one of the most important of those yet published by the Forest Service, and must prove of great value to students of forestry and especially of dendrology, while as a matter of course it will be indispensable to the systematic botanist. It may be asked why should the United States Forest Service incur the labor and expense of publishing a comprehensive work on the North American forest trees when we already have Sargent's "Silva" in fourteen great quarto volumes; Sargent's "Manual of the Forest Trees of North America"; and Britton's "North American Trees," but it does not require a long perusal of the book before us to convince one that it contains much that is not to be found in other books, and that it can easily justify its existence.

In the first place it is written from the dendrologist's point of view. It is rather a forester's book than one for the botanist, and so contains some things that are not to be found in other books on trees. Thus one finds under each species a paragraph relating to the longevity of the trees, another as to their particular habitat, still another in regard to the climatic conditions under which they grow, one on tolerance (of especial value to the practical forester) and one on their reproduction (also of very high value to the forester). The descriptions are non-technical and are accompanied by good life-size figures of characteristic parts, as leaves, cones, fruits, seeds and less commonly the flowers. In only a few instances was it necessary to reduce the figures below their natural size.

In the second place it is desirable that there shall be some authoritative silva for the use of the men who go into the United States Forest Service. In this book care has been taken in regard to the selection of English names for the species, and in like manner where there has been a question as to the proper scientific name one is here designated for use by the official dendrologist. In regard to this latter point it seems to the writer of this notice that on the whole a conservative course has been taken. While many trees appear here under unfamiliar names, there seems to be a good reason for every change made. There is an entire absence also of the species-making mania, and the reader soon gets the impression that the author is more interested in giving such a clear idea of the species that they may be recognized in the forests than in making out that certain observed variations are the sure indications of new species.

The definition of a tree followed by the author includes "woody plants having one well-defined stem and a more or less definitely formed crown, and attaining somewhere in

their natural or planted range a height of at least eight feet, and in diameter of not less than two inches." This definition is not, however, allowed to exclude unbranched cactuses, yuccas and palms. The uniform recapitalization of all specific names is greatly to be commended, as also the clear type (of two sizes) and the exact illustrations. Two good maps of the region covered and a good index complete this altogether admirable publication.

FUNGUS NOTES

In a recent number of *Rhodora* (January, 1908) Dr. W. J. Farlow begins the publication of "Notes on Fungi," which promise to yield critical discussions of much value. He shows that what has been known as *Corticium tremellinum* var. *reticulatum* is in the first place not a *Corticium*, but a *Tremella*, and that the variety is a distinct species, to be known hereafter as *Tremella reticulata*. He shows that what has been known as *Synchytrium pluriannulatum* (a parasite in species of *Sanicula*) is in reality *Urophlyctis pluriannulatus*, and that a uredineous parasite of *Rubus neglectus* and *R. strigosus*, hitherto known as, or confused with, *Phragmidium gracile* is *Pucciniastrum arcticum* var. *americanum*. He is further of the opinion that the *Pucciniastrum* on *Potentilla bidentata* is *P. potentillae*. Further notes from this source will be eagerly looked for by mycologists.

In *Annales Mycologici* (V., No. 7, 1907) Professor F. L. Stevens figures and describes "Some Remarkable Nuclear Structures in *Synchytrium*." The paper is a record of facts, and the author does not attempt to base any conclusions upon what he has yet seen. Other recent fungus papers by the same author are "An Apple Rot due to Volutella" and a "List of New York Fungi" in the March and May numbers of the *Journal of Mycology* (1907), and "The Chrysanthemum Ray Blight" in the *Botanical Gazette* (October, 1907). The fungus which causes the ray blight on the chrysanthemum appears to be new and is described as *Ascochyta chrysanthemi*.

Heinrich Hasselbring's paper on "The Carbon Assimilation of Penicillium" in the *Botanical Gazette* for March, 1908, is a contribution to our knowledge of the chemistry of the assimilation of some of the simpler compounds by plants. Among the results noted is the fact that "alcohol, acetic acid and the substances from which the acetic acid radicle CH_3COO — is easily derived are assimilated by *Penicellium glaucum*."

Mention should be made here of Scott and Rorer's paper "Apple Leaf-spot caused by *Sphaeropsis malorum*" in Bulletin 121 of the Bureau of Plant Industry of the U. S. Department of Agriculture; of W. H. Lawrence's record of "Some Imported Plant Diseases of Washington," in Bulletin 83 of the Oregon Experiment Station, and Cook and Horne's "Insects and Diseases of the Orange," in Bulletin 9 of Estacion Central Agronomica de Cuba.

Here also may be mentioned Professor Harshberger's paper "A Grass-killing Slime Mould" in the *Proceedings of the American Philosophical Society*, Vol. XLV., recording a case in which the plasmodia of *Physarum cinereum* killed the blades of grass over which they had grown.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

SOME REMARKS ON THE CULTURE OF EASTERN NEAR-ARCTIC INDIANS

During the past summer, 1908, the writer undertook an ethnological expedition into the James Bay region of Canada, for the Department of Anthropology of the American Museum of Natural History of New York. The original intention was to journey to Moose Factory and thence to the eastern coast of the bay, touching at Rupert's House, Eastmain River and, perhaps, Fort George, at which posts it was supposed access might possibly be had to the Naskapi Indians of Labrador, who, it was thought, might come down to these points during the summer, for the purpose of trade. On arriving at Moose Factory, it was learned that the Naskapi could not be reached *via* the west coast of Labrador, usually known

as Eastmain, and that they did not come out to any of the posts along that shore. At Nitchequon, a post situated in the Labrador interior, fifty-five days' journey from Rupert's House by canoe, and still in the hunting territory of the Northern Cree, the Naskapi are known to come in winter when driven by starvation. Otherwise they are confined to the interior of Labrador proper, held back on the east and north by the Esquimau, on the west by the Northern Cree, and on the south by the Montagnais.

As conditions were not favorable for study of the Naskapi, our attention was turned to the ethnology of the Northern Cree. The Northern, or perhaps more properly the Eastern, Cree range from Nitchequon on the north, south to the height of land around James Bay, west to the Albany River and Agomska Island. There are no Cree between this post and York, because the Northern Ojibway have worked northward to the coast and thus have separated the York Cree from the rest. So far as could be learned from the Hudson's Bay men and Indians, this has taken place within comparatively recent times, and it was also stated that the Western Cree came originally from the vicinity around James Bay, being induced to go westward by the Hudson's Bay Company. Both the York Cree and the Western Cree seem to be considered by the Eastern Cree to be somewhat different from the Eastern Cree, although admittedly the same people. Several dialects of their language are recognized by the eastern band, but the changes appear to be perfectly regular and phonetic, not affecting the grammar in any way.

The Eastern Cree claim to have always lived in the region that they now inhabit, and recognize several bands or subdivisions, known according to the locality which they inhabit. The Crees know themselves generally as Muskéko-wug, or "Swamp People." The social unit is the patriarchal family and there seems never to have been any clan organization among them. Village life is, and apparently was, unknown; for economic conditions caused single families to live by themselves, far apart from any others, and rendezvous was made every spring at some spot previously decided upon for the purpose of reuniting. At this time, the feasts, councils and meager ceremonies of these people were held. Nowadays, the hunters come to the Hudson's Bay posts every spring to trade their furs for supplies for the next year, and this coming together takes the place of the old spring meeting. Chiefs were never elected or chosen, but acquired their office through prestige by tacit consent on the death of the former incumbent. As the people rarely came together, excepting at the spring meetings, or in case of war, the chief's influence was small in comparison with that of the shaman. Shamanism, or "conjuring," as it is called in the north, is still quite extensively carried on for warlike expeditions, hunting, love-making and other purposes. Conjuring houses are still built and used. A shamanistic society, very loose in form, but apparently corresponding to the Midèwin of the Ojibway, occurs. There are but two degrees, and admission to these is through dreams. There are no initiatory ceremonies. So far as could be learned, members of this society do not attempt to cure disease. Apparently this is done by herb doctors.

The material culture of these people is now considerably debased through constant contact with the Hudson's Bay Company. Clothing in the old days was made of caribou skin, tanned without the hair in summer; in winter, of caribou skin with the hair, or of beaver and other furs. Garments were often made of twisted and woven rabbit skins. Coats with sleeves, hoods and mittens were worn by both sexes. The habitations consisted of conical or dome-shaped lodges, covered with painted skins, bark or brush. No mats were used for this or any other purpose, as articles of woven rabbit-skin seem the only fabrics made. Owing to climatic conditions, agriculture was unknown, a few berries furnishing the only vegetable food. Hunting, and, secondarily, fishing were the great resources of life. As hunting has not been checked, but rather given an impetus, by the advent of the Hudson's Bay Company, all the ancient superstitions regarding animal life may still be found in full force. Most interesting of these are a series

of observances regarding the killing of the bear. While all the eastern Algonkins have observances of this order, they seem to have become much more elaborated among the Eastern Cree.

Pottery was unknown, steatite taking its place. Semilunar knives, here used as scrapers, other knives and some arrow points were rubbed out from slate. In some parts, at least, arrow points seem to have been chipped; and in others, made of bone and antler. The grooved axe was used. Basketry, except simple vessels of birch or pine bark, was unknown. Birch bark canoes were used.

Syllabics, invented by missionaries, are now used for communication in their own language, though the Cree still employ mnemonic devices of their own invention for the same purpose. Information was obtained which seemed to show that in olden times pictorial writings on birch bark, similar to those found among the Ojibways, were known. The primitive form of art seems to have been painting, and the lines employed were geometric.

Little folk-lore was collected, and this was, in the main, typically Algonkin, but some apparently resembles the Esquimau.

A comparison of the writer's notes with Lucien M. Turner's account of "The Nenenot or 'Naskopie'" Indians,[1] and conference with Indians and white men who had been in the Naskapi country, seems to show that the culture of these people is identical with that of the old Cree. Considering the absence of agriculture, the lack of village life and clan systems, the loose social and political organization, the absence of pottery and the ordinary forms of fabrics, and the comparative difference of artifacts in general, as here noted—it may perhaps be well no longer to consider the region inhabited by the Eastern Cree and the Naskapi as belonging to the Eastern Woodland culture area, a region characterized throughout by its agricultural and village life, its comparatively highly developed social and political organization, its pottery, clothing made from skins tanned without the hair, fabrics, woven basketry, and the like. Dr. Frank G. Speck, of the Department of Archeology of the University of Pennsylvania, who spent last summer among the Montagnais of Lake St. Johns, arrived independently at the same conclusion in studying these people. It is the suggestion of the writer, then, that the culture of the region of Subarctic Eastern America inhabited by the Cree, Naskapi, and Montagnais, might better be known hereafter as the Eastern Subarctic, or Labradorean, cultural area, as it is apparently so different from the eastern woodland area with which it has hitherto been classed.

[1] Lucien M. Turner, "Ethnology of the Ungava District," Eleventh Annual Report, Bureau of Ethnology, 1889–90, pp. 167–350.

ALANSON SKINNER
AMERICAN MUSEUM OF NATURAL HISTORY

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION A—MATHEMATICS AND ASTRONOMY

COMPARATIVELY few papers on pure mathematics appeared on the program of Section A in view of the fact that the American Mathematical Society held its annual meeting in affiliation with the association. The address of the retiring vice-president, President E. O. Lovett, the Rice Institute, Houston, Texas, was read by the secretary of the section. It was entitled "The Problem of Several Bodies, Recent Progress in its Solution," and an abstract of it has appeared in a recent number of SCIENCE.

The following members of the section were elected as fellows of the association: David R. Allen, Joseph Allen, R. B. Allen, Harriet W. Bigelow, Oskar Bolza, W. H. Bussey, B. E. Carter, E. F. Chandler, Abraham Cohen, E. H. Comstock, H. A. Converse, S. A. Corey, J. A. Cragwall, F. F. Decker, C. C. Engberg, F. C. Ferry, F. E. Fowle, Philip Fox, William Gillespie, C. C. Gore, C. O. Gunther, U. S. Hanna, A. E. Haynes, Alfred Hume, W. J. Hussey, Kurt Laves, A. H. McDougall, Max Mason, Frank E. Miller, J. S. Miller, W. F. Osgood, J. M. Page, M. T. Peed, James Pierpont, S. C. Reese, W. J. Rusk, P. L. Saurel, G. T. Sellew, E. B. Skinner, A. G. Smith, D. E. Smith, P. F. Smith, Joel Stebbins, R. P. Stephens, L. B. Stewart, H. D. Thompson, E. B. Van Vleck, Oswald Veblen, H. S. White, F. S. Woods.

The sectional committee of Section A nominated the following members of the association,

who had not affiliated with any particular section, for fellowship in the association: Eugene Davenport, dean of the College of Agriculture, University of Illinois; E. K. Putnam, acting director of the Davenport Academy of Sciences; J. E. Stubbs, president of the State University of Nevada. These were also elected as fellows by the council.

In addition to the address of the vice-president, the following sixteen papers were read before the section:

1. V. M. Slipher: "The Spectrum of Mars."

2. E. B. Frost and J. A. Parkhurst: "Spectrum of Comet Morehouse."

3. E. E. Barnard: "On the Changes in the Tail of Comet Morehouse."

4. Frank Schlesinger: "The Orbit of the Algol-type Variable Delta Libræ."

5. Milton Updegraff: "The 6-inch Transit Circle of the U. S. Naval Observatory."

6. F. R. Moulton: "On Certain Implications of Possible Changes in the Form and Dimensions of the Sun, and Some Suggestions for Explaining Certain Phenomena of Variable Stars."

7. R. H. Baker: "On the Spectra of Alpha Virginis and Similar Stars."

8. F. C. Jordan: "The Orbit of Alpha Coronæ Borealis."

9. E. B. Frost: "Radial Velocities in Professor Boss's Star Stream in Taurus."

10. Philip Fox and Georgio Abetti: "The Interaction of Sun-spots."

11. Harris Hancock: "Elliptic Realms of Rationality."

12. Artemas Martin: "Algebraic Solution of the 'Three Point' Problem."

13. J. B. Webb: "Esperanto and a Sexdecimal Notation."

14. J. A. Miller and W. R. Marriott: "Comet Morehouse."

15. L. A. Bauer: "On the Interpolation Formula of Geophysics."

16. H. W. Fisk: "A Graphical Aid to the Determination of Latitude and Azimuth from Polaris Observations."

In the absence of their respective authors the paper by V. M. Slipher was read by J. A. Miller; the joint paper by E. B. Frost and J. A. Parkhurst was presented by W. S. Eichelberger; the three papers by Frank Schlesinger, R. H. Baker and F. C. Jordan, respectively, were read by J. A. Brashear; F. R. Moulton's paper was read by E. D. Roe; G. F. Hull presented the two papers by E. B. Frost and by Philip Fox and Georgio Abetti, respectively; the papers by E. E. Barnard and Artemas Martin, respectively, were read by title. The remaining papers were read by their respective authors and the abstracts which follow bear numbers corresponding to those of the titles in the list.

1. The paper by Mr. Slipher gives the results of a photographic investigation of the extreme red end of the spectrum of Mars made with special reference to water-vapor in the planet's atmosphere. It is a part of an extensive and detailed presentation which is to appear in the *Astrophysical Journal*.

2. The comet was observed photographically with a prismatic camera or with a quartz spectrograph on fifteen nights. The third and fourth carbon bands were identified, and the first, third and fourth bands of cyanogen. The plates taken with the objective prism over the six-inch Zeiss doublet show well the separate spectral images of the tail, running off the plate in most cases at a distance of over 3°. Wave-lengths were given off from unidentified bands. A brief account of the observations by E. B. Frost and J. A. Parkhurst appeared in SCIENCE, January 2, 1909.

3. Professor Barnard's paper deals with the remarkable changes in the appearance of the comet and of its tail as shown by the photographs of it, and an attempt to explain the phenomena.

There were a number of outbreaks in the comet in which volumes of matter were thrown off which could be traced for several days, on the photographs, as they receded from the comet. On one occasion the tail was violently curved and switched forward in the direction of its lateral motion. At another time the masses not only receded from the comet, but their lateral motion was also accelerated and became greater than that of the comet in the same direction. This acceleration was apparently in defiance of the laws of gravitation.

It is suggested as an explanation of these anomalous phenomena that disturbances of some kind occur in the interplanetary spaces, perhaps temporary in their nature and location, which may accelerate or retard, and bend or break the tail of a comet when they are encountered by it. It is suggested, also, that these regions of disturbance may be due to the same or a similar cause as that which produces magnetic disturbances on the earth—that is, that they are due to forces which are encountered by the comet and which have their origin in disturbances on the sun. An encounter of this kind might account for the sudden brightening of some comets, such as that of Sawerthal's in May, 1888. It might also cause the disruption of large volumes of the

cometary matter such as are shown in the photographs of Morehouse's comet on October 15, etc.

4. Sixty spectrograms of this Algol-type variable were obtained at the Allegheny Observatory during this year. These indicate a nearly circular orbit with a range of 146 kilometers per second. The center of gravity of the system is approaching us at the high rate of 46 kilometers per second. The light curves of this variable has been the subject of a recent exhaustive investigation by Kron. A study of the results obtained by him, and of the spectrographic data, enables us to infer the following with regard to the constitution of the system, upon the assumption that the light changes are caused by an eclipse. The two stars in the system have nearly equal diameters (about two and a half that of the sun), but one of them is nine times as bright as the other. Their average separation is about one thirtieth of that between the earth and the sun. If we assume that the two stars are equally dense the mass of each would be about six tenths and the density about one twenty-fifth that of the sun.

In discussing a series of measurements made two years ago upon *β Persei*, Professor Schlesinger showed that in the case of this star there is a discrepancy between the phase demanded respectively by the light and velocity changes. Further investigation has confirmed the reality of this discrepancy and has shown that it can not be accounted for by any uncertainties in either the photometric or spectrographic data. It is interesting to notice that the same discrepancy is present in the orbit of *δ Libræ*. In this case the light phase lags more than two hours behind the velocity phase. The discrepancy is, therefore, somewhat greater than in the case of *β Persei*, but it is in the same direction.

5. Professor Updegraff gave the following account of the six-inch transit circle of the U. S. Naval Observatory:

This instrument was acquired by the Naval Observatory with a view to its employment in doing fundamental work. The nine-inch brass transit circle made by Pistor and Martins, of Berlin, and mounted in the old Naval Observatory in 1865 was considered unsuitable for fundamental work of the highest class, and after the removal of the observatory to the new site on Georgetown Heights about the year 1893, the new six-inch steel transit circle was designed by Professor Wm. Harkness and was built by the well-known instrument makers, Warner & Swasey, of Cleveland, Ohio. The instrument was mounted in the west transit circle house at the new Naval Observatory in December, 1897, and was first brought into use in June, 1899. A description of the six-inch transit circle may be found in volume III., Part 4, of the *Publications* of the Naval Observatory, together with an account of the work done with it up to March, 1901.

The design of the instrument is substantially the same as that of the later Repsold meridian circles, and certain features have been the subject of considerable controversy. It was, I think, the first large instrument of this kind to be built of steel, which being a much stiffer metal than brass is expected to diminish errors due to flexures. This feature has been much criticized, but the example set by Professor Harkness has been followed by the Repsolds in making the new transit circle for the observatory at Kiel, Germany, which is also of steel, and the prospect is that steel or some other rigid metal will finally be recognized as preferable to brass for the construction of large instruments of this kind.

When brought into use the new instrument was found to have various defects, the most important of which, an extraordinary variability in azimuth, was found to be intimately connected with temperature. After a very troublesome investigation this was found to be due to two causes. The cast-steel bed plates which supported the instrument were, through non-homogeneity of the metal, distorted by temperature changes, and the marble piers of the instrument were not properly supported on their foundations. New bed plates of cast iron were provided, and the marble piers of the instrument were replaced by brick piers. These measures gave relief, and rendered the instrument remarkably stable in azimuth.

A peculiar but not serious difficulty has arisen from the construction of the tube of the telescope of steel. In a brass telescope of moderate size the changes in focal length of the object glass with temperature is nearly the same as the expansion and contraction of the tube with changes of temperature. But the coefficient of expansion of steel is smaller than that of brass, and in the case of the tube of the six-inch transit circle is not sufficient to make up for the change of focus of the object-glass. This makes necessary a change of stellar focus from winter to summer and vice versa.

In the fall of 1901 the instrument had been put in good condition, and for about one year following was employed in observations of the fixed stars and also in observations of the sun, moon and planets. The latter work with the instrument was continued up to September, 1903, when work

was discontinued, and practically no observations have been made with it since that time. In 1906 a transit micrometer made by Warner & Swasey was substituted for the old eye-end and a few practise observations were made by various observers.

The plan for the future work of the instrument is given in a general way in the report of the superintendent of the U. S. Naval Observatory for the fiscal year ending June 30, 1908, which has just been issued. This plan involves an attempt to render the observations of the sun and fixed stars and, consequently, of all bodies which are referred to them, of as strictly fundamental a character as is practicable.

The importance of such work to the science of astronomy and in the plan of work of an observatory maintained by the government is generally recognized by astronomers. It is expensive and laborious and in some respects perhaps less attractive than some other kinds of astronomical work in that it can not excite the interest or occupy the attention of the general public to any great extent. But for its proper performance, technical qualifications of a high order are required. Partly for these reasons, no doubt, this work has, with a few notable exceptions, not been as efficiently done in the observatories of the world generally for many years as is needed for the advancement of astronomy.

All accurate observations of the positions of the planets depend on this work and it thus becomes in some degree necessary for the further advancement of celestial mechanics. It is equally important for the solution of that greatest problem of physical science, the constitution of the visible universe, which must perhaps wait on further lapse of time and increase in accuracy of the observations of the places of the stars.

The late Professor Asaph Hall, U.S.N., was much interested in this kind of astronomical work, as may be seen by consulting the *Ast. Nach.*, No. 1692.

6. The problems treated in the paper by Professor Moulton are: (1) The theoretical shape of the sun, (2) the character and period of its possible gravitational oscillations, (3) the effects of changes of its dimensions upon its rate of rotation, (4) its energy of rotation, (5) its potential energy, (6) its temperature and rate of rotation and (7) applications of the same ideas to variable stars.

The results are: (1) the sun is oblate and the theoretical difference in its polar and equatorial diameters is less than 0".01. (2) Its gravitational oscillations are expressible in spherical harmonics whose periods depend upon their order. Assuming the sun to be a homogeneous liquid, the longest period is 3 h. 8 m. If it has the viscosity of water this oscillation will change to 37 per cent. of its value in 2.2×10^{13} years. (3) The change of the sun's diameter by 0".1 will change its period of rotation by 7.8 minutes. (4) The formula was found for the change in the rotational energy. (5) The formula for the potential of spheroid of polar radius c, equatorial $c\sqrt{1+\lambda^2}$, and mass m upon itself is

$$V = \tfrac{3}{5}k^2 \cdot m^2/c\left(1 - \tfrac{1}{3}\lambda^2 - \tfrac{7}{15}\lambda^4 \cdots\right).$$

(6) The expansion of the sun by 0".1 will decrease its temperature (assuming its specific heat is unity) more than 1,400° C., and if it obeys Stefan's law, diminish its radiation (assuming its temperature to be 6,000° before expansion) by more than 65 per cent. (7) It is shown how gravitational oscillations can explain many puzzling phenomena of variable stars, such as variable periods in the so-called eclipse variables, secondary maxima and minima, varying maxima and minima, etc. It is thought that these factors are supplementary even in those cases where the binary character of the star is certain, and that perhaps in certain classes of stars they may be the only causes of variability.

7. Spectroscopic binaries of the helium type may be divided for convenience into two classes: those of long period and high eccentricity, and secondly, those whose periods are short and whose orbits are nearly circular. Mr. Baker's paper relates to the latter and much more numerous class, of which *α Virginis* is typical. This class includes a large number of Algol variables, as a special case where the orbital inclination approaches 90°, if the eclipse theory of their light variation be assumed. The following conclusions were reached: The majority of spectroscopic binaries of the helium type belong to one class, they revolve in close proximity in nearly circular orbits of short period, they are Algol variables inclined at various angles, the spectra of both components are, in general, visible and similar, and the fainter components are less massive than the brighter ones.

8. The binary character of *α Coronæ Borealis* ($\alpha = 15^h\ 30^m$, $\delta = +27°\ 3'$) was discovered by Hartmann from six plates obtained at Potsdam in 1902 and 1903. The spectrum is of the type 1 a 2 in the Vogel classification.

One hundred and thirty-seven plates of this star were obtained at Allegheny Observatory between

April 2, 1907, and September 11, 1908. The emulsions used were Seed 27, Seed 23 and lantern slide. The lines K, $H\delta$, $H\gamma$, λ 4481 and $H\beta$ were the only ones measured. On the lantern slide and Seed 23 plates numerous other faint lines were visible, and in some cases measurable, but were not used. Among them are the lines λ 4128 (silicon), λ 4227 (calcium), λ 4233 (iron), λ 4352 (magnesium), λ 4472 (helium), λ 4550 (iron). A dozen other lines could be approximately located, while still others were occasionally faintly visible.

Mr. Jordan found that the total range in velocity is 69.86 km. As the periastron point is in the fourth quadrant, the ascending branch of the velocity curve is steeper than the descending. The center of gravity of the system has practically no velocity in the line of sight.

No trace of a secondary spectrum can be seen.

9. In No. 604 of the *Astronomical Journal*, published on September 25, 1908, Professor Lewis Boss communicated an important paper entitled "Convergent of a Moving Cluster in Taurus." In this he presents the evidence, derived from their proper motions, that 39 stars in or near the *Hyades* are converging upon the same point. Radial velocities have been published by Küstner for three stars of the cluster, namely, γ, δ and ϵ *Tauri*. Assuming these values to be representative of the cluster, the radial velocities of the remaining stars can be inferred. They would range from 37 to 44 km. per second. Before the article was printed Professor Boss had privately called the attention of Professor Frost to his results and to the desirability, in so far as possible, of determining the radial velocities of the stars in the cluster. He accordingly added the 41 stars to the observing program of the spectrograph, and during the present autumn they have been observed, as circumstances permitted, chiefly by Messrs. Barrett and Lee.

The spectra of most of the stars are of the first type, so that the lines are generally diffuse and suitable for only the dispersion of the single prism which has been regularly employed for them.

There has not yet been opportunity to measure these plates and this note is merely given to state that this piece of work is in progress. Thus far 60 spectrograms have been obtained of 21 of the stars, the magnitude of which are mostly between 4.5 and 5.6.

It may be said from a preliminary examination of the plates that no star contradicts in sense the value presumptive from Professor Boss's researches, and in general the radial velocity appears to be of about the amount expected. Some of the spectra will hardly admit of accurate enough measurement to establish the accordance with the predicted values. This examination only indicates that the stars thus far observed are receding from the sun with velocities of about 40 km. per second. No inference can yet be reached as to the differences in radial velocity dependent upon the star's position in relation to the point of convergence.

We have been somewhat surprised at the large proportion of spectroscopic binaries already detected in this cluster. Six of those so far observed appear to be certainly of this character, and others are suspected.

The six are: *90 Tauri* and B.D. 15°.637, found by Mr. Barrett; *64 Tauri* and *97 Tauri*, found by Mr. Lee; θ^2 *Tauri* and *69* (Upsilon) *Tauri*, found by the writer. The last two had been observed before Professor Boss called attention to the cluster. θ^2 *Tauri* has also been detected as a spectroscopic binary at the Lick Observatory. Double lines are exhibited by the first two and last three stars.

10. The paper by Messrs. Fox and Abetti presents evidence proving occasional interaction of sun-spots. On spectroheliograms obtained on September 10, 1908, regions surrounding three spot groups then just past the central meridian were observed to burst synchronously into active eruption. The eruptions progressed until the interval between the two larger groups, about 120,000 miles, was completely and brilliantly bridged. The whole display lasted less than four hours. Successive plates, shown by lantern slides, revealed the progressive stages of the demonstration.

11. It is known that on the Riemann surface associated with

$$s = \pm \sqrt{A(z-a_1)(z-a_2)(z-a_3)(z-a_4)},$$

in which a_1 and a_2 are connected by a canal as are also a_3 and a_4, that every one-valued function of position which has everywhere a definite value is of the form

$$w = p + q \cdot s,$$

where p and q are rational functions of the complex variable z; and reciprocally every function of the form

$$w = p + q - s$$

is a one-valued function of position on this Riemann surface. If we denote two such functions by

$$w_1 = p_1 + q_1 \cdot s, \quad w_2 = p_2 + q_2 \cdot s,$$

then the sum, difference, product and quotient of the two functions w_1 and w_2 are functions of the form

$$w = p + q \cdot s.$$

Let z take all real and complex values and consider the collectivity of all rational functions of z with arbitrary constant real or complex coefficients. These functions form a closed realm, the individual functions of which repeat themselves through the processes of addition, subtraction, multiplication and division, since clearly the sum, the difference, the product and the quotient of two or more rational functions is a rational function and consequently an individual of the realm. This realm is denoted by (z).

It is evident that if we add (or *adjoin*) the algebraic quantity s to this realm we will have another realm, the individual functions or elements of which repeat themselves through the processes of addition, subtraction, multiplication and division. This realm includes the former realm. We shall call it the elliptic realm and denote it by (s, z).

Owing to a theorem due to Liouville, the most general one-valued doubly periodic function is a rational function of z and s. It is consequently a one-valued function of position in the Riemann surface and belongs to the elliptic realm of rationality (z, s).

The elliptic or doubly periodic realm of rationality (z, s), where

$$s = \pm \sqrt{A(z-a_1)(z-a_2)(z-a_3)(z-a_4)}$$

degenerates into the simply periodic realm when any pair of branch-points are equal, say $a_1 = a_2$; and into the realm of rational functions when two pairs of branch points are equal, say $a_1 = a_2$ and $a_3 = a_4$.

Thus the elliptic realm includes the three classes of one-valued functions: (1) the rational functions, (2) the simply periodic functions, (3) the doubly periodic functions. All these one-valued functions, and only these, have algebraic addition-theorems.

In other words, *all functions of the realm (z, s) have algebraic addition-theorems, and no one-valued function that does not belong to this realm has an algebraic addition-theorem.*

We have thus the theorem: The one-valued functions of position on the Riemann surface

$$s^2 = A(z-a_1)(z-a_2)(z-a_3)(z-a_4)$$

belong to the closed realm (z, s) and all elements of this realm and no others have algebraic addition-theorems.

Professor Hancock's paper will be offered to the *American Journal of Mathematics* for publication.

12. The paper by Artemas Martin is devoted to an algebraic determination of the point within a triangle at which the sides subtend given angles. The paper is to appear in the *Mathematical Magazine*, which is edited by the author of this paper.

13. The paper by J. Burkitt Webb is devoted to exhibiting the advantages which would result from the adoption of a system of notation with 16 as its base. The success which has attended the movements towards a universal language has inspired the author with hope in the success of a movement towards the selection of a more useful system of notation, and he pointed out the many advantages which the base 16 would offer.

14. This paper is devoted to a discussion of a series of photographs of comet Morehouse, made at Swarthmore College by J. A. Miller and W. R. Marriott from October 2 to December 3, 1908. The comet was photographed from one to three times every clear night within that period. These photographs show remarkable and, in some instances, rapid changes in the form of the comet's tail and in the arrangement of the streamers. The most striking changes occurred on October 4; on October 15, 16, 17, 30, 31 and November 1 the changes were sufficiently rapid to enable one to measure an increase of the distance of a condensation in the tail upon photographs taken less than two hours apart.

15. The rather prevalent custom of resolving or expressing every natural phenomenon—be it periodic or otherwise—by a Bessel or a Fourier series or by spherical harmonic functions, has brought about at times, especially in geophysical and cosmical phenomena, if not direct misapplications, at least misinterpretations of the meaning and value of the derived coefficients. Instead of clarifying the situation our calculations may have actually contributed to befog it. Instead of rejecting, one must learn to consider the outstanding residuals as the *true* facts of nature and not treat them as though they were "abnormal" or contrary to nature's law.

Dr. Bauer exemplified these statements in a brief discussion of two cases that are typical in geophysical investigations—the one involving an application of spherical harmonic functions to the representation of the distribution of the earth's magnetism over the earth, while the other involved the use of Fourier series in the representation of certain diurnal geophysical phenomena.

The chief purpose of the paper was to recall

renewed attention to the limitations, from a physical standpoint, of the form of "interpolation formulæ" usually employed in the representation of natural phenomena.

16. Mr. H. W. Fisk considers the formula for latitude,

$$\phi = h - p \cos t + \tfrac{1}{2} p^2 \sin 1' \sin^2 t \tan h,$$

from Chauvenet's I., § 176, and the formula for azimuth,

$$A = p \sin t \sec \phi + p^2 \cos \phi \tan \phi \sin t \cos t \sin 1',$$

from Jordan, "Zeit und Orts-Bestimmung," p. 122. The first terms of these formulas are readily computed. The last terms, called correction terms, are arranged as a set of curves from which the value is quickly taken by inspection. The geographical limits within which this method may be used, as well as the expected accuracy under different conditions are discussed. Attention is given to the change in correction terms due to the progressive change in the value of p.

The general committee elected Professor E. W. Brown, Yale University, vice-president and chairman of the section. Professor G. A. Miller, University of Illinois, continues in office as secretary. The section elected Professor G. B. Halsted, councilor; Professor Winslow Upton, Ladd Observatory, as member of the sectional committee for five years.

G. A. MILLER,
Secretary of Section

UNIVERSITY OF ILLINOIS

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

THE fifty-first meeting of the Washington Academy of Sciences was held at Hubbard Memorial Hall, January 5, 1909. Dr. L. O. Howard presided.

Dr. E. B. Poulton, F.R.S., Hope professor of zoology in the University of Oxford, delivered an address on "Recent Researches on Mimicry and Seasonal Forms of Butterflies," of which he has kindly furnished the following abstract:

The lecturer explained the theory of mimicry proposed by H. W. Bates, showing in illustration some of the figures from the plates of the original monograph read before the Linnean Society of London, November 21, 1861. In these, as in most of Bates's examples, Pierine butterflies, presumed to be palatable to enemies, were seen mimicking the unpalatable Ithomiine (Heliconine) butterflies from the same localities. Succeeding illustrations exhibited oriental Pierine butterflies of the genus *Delias* acting as models instead of mimics, and beautifully resembled by moths of the subfamily Chalcosiinæ (Zygænidæ)—themselves admitted to belong to a group defended by its unpalatability. Such examples are of course inexplicable by the theory of Bates, but receive an interpretation on the hypothesis of Fritz Mueller, which supposes that the resemblance between distasteful forms has been gained in consequence of the saving of life effected by a lessened amount of experimental tasting by enemies. That the same Muellerian principle holds in other groups is seen in the numerous and varied distasteful forms which mimic the African Lycid beetles and by resemblances between well-defined wasps of different groups in the same locality.

The alternative between a Batesian and Muellerian interpretation may be approached from another point of view. In the case of a distasteful butterfly invading a new country we may enquire whether the indigenous species influenced by it are well concealed and presumably palatable, or conspicuous and presumably distasteful. The two large Danainæ of North America are especially interesting from this point of view. Formerly placed by Moore in two genera peculiar to the new world, *Anosia* and *Tasitia*, recent examination has shown that they are congeneric with each other and with the more dominant old world *Salatura* and *Limnas*. All four genera certainly sink to *Danaida*. The old world forms are more numerous and are far more extensively mimicked than those of the new. They, furthermore, enter into mimetic relations with other *Danainæ*. The American species of *Danaida*, on the other hand, are only mimicked by a single Nymphaline species in the north. They extend through South America beyond the southern tropic without entering into any relationship with the indigenous butterfly fauna, except the possible incipient mimicry of a form of *D. plexippus* by an *Actinote*, one of the Acræinæ. It may be inferred from these facts that *Danaida* is an old world Danaine genus which has reached the new world in comparatively recent times and has entered South America by way of North America.

The well-known mimic of *D. plexippus*, *Basilarchia* (*Limenitis*) *archippus* has been evolved from *B.* (*L.*) *arthemis*—with a pattern of the *Limenitis* type found through the temperate circumpolar belt. In the theory of the production of mimetic resemblance by climatic or other local influences the invading Danaine should have been influenced to produce a *Limenitis* pattern in the northern temperate zone. It should have been the mimic instead of the model. The black and white

pattern and conspicuous surface of the form (*B. arthemis*) which has been influenced supports strongly the Muellerian hypothesis. The mimic has in fact exchanged its original conspicuous pattern similar to that of the invading Danaine.

Danaida berenice of Florida is probably a later invader than *plexippus* and has modified into resemblance with itself the mimic already formed under the influence of this last-named Danaine. But the change is so recent that distant traces of the original mimicry of *plexippus* are easily seen in the *floridensis* (= *eros*) form of *archippus*.

Evidence in favor of the Muellerian hypothesis is also to be found in the complex group of mimetic butterflies which are ranged round the North American *Papilio* (*Pharmacophagus*) *philenor*. The female of *Papilio asterius*, a female form of *P. glaucus* (= *turnus*), and both male and female of *P. troilus* form primary mimics of *philenor*, but also appear to exhibit an evident secondary approach towards one another. *Basilarchia* (*Limenitis*) *astyanax*, considered by Haase as a mimic of *philenor*, is rather to be interpreted as a secondary mimic of the three mimetic swallow-tails. The female of *Argynnis* (*Semnopsyche*) *diana*, also thought by Haase to be a mimic of *philenor*, certainly resembles *B.* (*L.*) *astyanax*, as was clearly stated by Scudder. It is therefore a tertiary mimic. These complex resemblances to mimics and even to mimics of mimics rather than to the central model, are intelligible on the hypothesis of Fritz Mueller and not on that of H. W. Bates.

The concluding section of the address dealt with recent additions to our knowledge of the complex phenomena of mimicry in the females of the African *Papilio dardanus* (= *merope*), and with seasonal changes in African Nymphaline butterflies. A representation of a family of 28 individuals bred from the eggs laid by a *hippocoon* female of the South African *P. dardanus cenea* was thrown upon the screen. The family consisted of 14 non-mimetic males, 3 *hippocoon* females, like the parent, mimicking the Danaine *Amauris niavius dominicanus*; 3 *trophonius* females, mimicking *Danaida chrysippus*; and 8 *cenea* females, in part mimicking *Amauris albimaculata* and in part *Amauris echeria*. The recently described *flammoides* female form of the tropical subspecies of *dardanus*, extending from Nairobi westward to the Atlantic, was also represented. This is the only form which resembles a model other than a Danaine—the Acræine *Planema poggei*. The evolution of the mimetic forms of *dardanus* from a non-mimetic female like that of the Abyssinian *P. antinorii* or the Madagascar *P. meriones* was shown to be readily intelligible through the intermediate form *trimeni* from the Kitnya escarpment.

In addition to the seasonal forms of the African species of *Precis*—*sesamus*, *antilope*, *actia*, *archesia* and *artaxia*, the recent evidence that similar changes may occur in the genus *Charaxes* was described and illustrated on the screen. A family of individuals bred from eggs laid by *Charaxes neanthes* contained one specimen of *C. zoolina*. This fact confirmed and placed beyond controversy the evidence that had long been accumulating that these are but forms of a single species.

This interesting and conclusive evidence has been obtained at Durban, Natal, by Mr. G. F. Leigh, who also bred the large family of *P. dardanus*, already referred to. The conclusions as to the seasonal forms of *Precis* are founded on the specimens bred by Mr. Guy A. K. Marshall at Salisbury, Mashonaland.

J. S. DILLER,
Recording Secretary

THE BOTANICAL SOCIETY OF WASHINGTON

THE 50th regular meeting of the society was held on November 21, 1908, Vice-president Thos. H. Kearney presiding. The following papers were read:

Plant Breeding in England and Sweden: DR. ALBERT MANN.

Dr. Mann's paper, which was illustrated by a number of excellent lantern slides, treated chiefly of the methods of culture of barley, as observed by him during a recent trip to England and Sweden. In England he visited Mr. Beaven, of Warminster; Professor Biffen, of Cambridge, and John Garton, of Warrington. His observations showed that English barley culture is carried to much higher perfection than in the United States; that two-row barley, except in yield, is generally preferred; and that pedigree stock is the only source of permanent grain improvement. At Svalof, Sweden, an ingenious system of classification and original methods of breeding have produced remarkable results. The two chief ideas of Svalof, namely, the securing of new varieties by selection from old land races and the production of pure pedigree stock by growing such from a single mother plant were fully discussed and in general heartily commended. Information of minor importance was secured from Professor de Vries, of Amsterdam; Professor Johannsen, of Copenhagen; Professor von Tschermak, of Vienna,

and Professor Kraus, of Munich. The relative lack of information in the United States as to work done by European barley-growers was in strong contrast to the accurate data possessed by them in regard to work in this country. Mr. E. S. Beaven, of Warminster, not only knew definitely the quality and yield of all our American barleys, but he also had samples of every variety from every section of this country. This spirit of progressiveness is deserving of our attention. Mr. Beaven spoke highly of our California brewing barley, but he had a less favorable opinion of our other grades, especially of some now grown in the northwest.

The use of Timbe Barks by the Mexicans in the preparation of Alcoholic Drinks: W. E. Safford.

Timbe, or timbre, is a name applied to certain barks and roots offered for sale in the markets of San Luis Potosí and several other Mexican cities for use in the manufacture of pulque. They have a bitter astringent taste and evidently abound in tannic acid. On the Pacific coast of tropical Mexico the same name is applied to certain barks used in tanning leather. The identity of the principal timbes has not hitherto been established and the part they play in the manufacture of pulque has not been understood. Among the most important plants from which they are obtained are *Acacia filicioides*, the principal source of the San Luis Potosí supply, and a sumach, *Rhus pachyrrachis*. Other barks used for a similar purpose are those of *Calliandra grandiflora* and *Calliandra Houstoni*, the latter of which is also used extensively by the Mexicans as a cure for intermittent fever, under the name of pambotano. At first the sap of the agave from which pulque is made is sweet and clear. It is sold about the streets in this condition under the name of *aguamiel* (honey-water). It soon begins to ferment spontaneously and becomes milky and finally stringy, acquiring a putrid smell, if unchecked, from the fermentation caused by the lactic-acid bacteria contained in it. The timbe bark, after having been toasted and pounded, is added to the sap about four hours after the fermentation has begun. It has the effect of precipitating the greater portion of mucilaginous substances held in solution, undoubtedly owing to the action of the tannic acid in the bark upon the proteids, which, if let alone, would cause the liquid to putrify or turn sour. Its action, then, may be compared to that of hops in the manufacture of beer, which probably do not destroy the lactic bacteria, but cause the precipitation of albuminous material. In addition to this the timbe imparts a pleasant bitter taste to the drink.

W. E. Safford,
Corresponding Secretary

THE TORREY BOTANICAL CLUB

The meeting of November 25, 1908, was called to order at the museum building of the New York Botanical Garden at 3:40 P.M., with Dr. M. A. Howe in the chair. Fourteen persons were present. The minutes of the meeting of November 10 were read and approved.

The resignation of Dr. Valery Havard, dated November 8, 1908, was read. A motion was made and carried that the resignation of Dr. Havard be accepted and that his name be transferred to the list of corresponding members.

There was no announced scientific program for this meeting, but the following communications were made:

Dr. Britton showed fruits of the rare and local tree, *Prioria copaifera* Griseb., which he collected, in company with Mr. William Harris, at Bachelor's Hall, Jamaica, near where it was originally discovered sixty years ago by Nathaniel Wilson, who sent it to Grisebach. *Prioria* is one of the largest trees of Jamaica, sometimes attaining a height of ninety feet, and is a member of the senna family. So far as is known, this tree is found only on two estates in Jamaica, and grows at an elevation of from five to six hundred feet. This species is characterized by having a one-seeded legume, which is indehiscent. The genus *Prioria* is reported to be represented also in the Republic of Panama.

Dr. Murrill displayed photographs and colored drawings of several of the larger local fungi. He also explained reproduction of colored drawings by the four-color process. This process seems to be the most satisfactory for representing fungi in colors.

Mr. Nash exhibited a living plant of *Dendrobium Cœlogyne*, a rare orchid from Burma, which has just flowered in the conservatories of the New York Botanical Garden. Specimens of *Cœlogyne* and of other species of *Dendrobium* were also shown to illustrate the characters of these two genera. While the flowers of *Dendrobium Cœlogyne* resemble those of a *Dendrobium*, the habit is that of a *Cœlogyne*.

Percy Wilson,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, JANUARY 29, 1909

CONTENTS

THE INFLUENCE OF THE MATERIAL OF WIND-INSTRUMENTS ON THE TONE QUALITY[1]

SOUND is the sensation resulting from the action of an external stimulus on the sensitive nerve apparatus of the ear; it is a species of reaction against this external stimulus, peculiar to the ear, excitable in no other organ of the body, and completely distinct from the sensations of any other sense.

Atmospheric vibration is the normal and usual means of excitement for the ear, this vibration being produced directly in some instruments, called wind-instruments, and indirectly through the vibration of elastic bodies in others, such as string and percussion instruments; and often the vibration originates in bodies not especially designed for producing sounds.

Physics is mainly concerned with the nature of the external stimulus, and the word sound is often restricted to refer only to these external stimuli. But the purely mechanical properties of these stimuli often differ among themselves differently than do the auditory effects. Our interest is largely in relation to musical sounds and hence for the present investigation we are concerned with the properties of the sounds of mechanical physics only in so far as they affect the ear, or produce sensation. We may, therefore, define sound substantially in the words of Helmholtz, as already given, and proceed

[1] Address of the vice-president and chairman of Section B, American Association for the Advancement of Science, delivered December 29, 1908.

to investigate the physical cause of these sensations.

If we investigate how many kinds of sensation the ear can generate, we find that, either because of fundamental or acquired distinctions, the ear divides sounds roughly into two main classes, noises and musical tones. Helmholtz's distinction between tone and noise, that one is periodic and the other non-periodic, in the light of recent experiments, seems hardly adequate. Analysis clearly shows that many musical tones are non-periodic, at least in the sense intended; and it is equally certain that noises are as nearly periodic as are some tones. In some instances noises are due to a rapidly changing period, causing non-periodicity; but by far the greater number of noises, which are continuous, are merely complex and only apparently irregular; their analysis is difficult or impossible. The ear, often because of lack of training, or the absence of suitable standards for comparison, or perhaps on account of fatigue, fails to appreciate the relations between certain sounds, and, resigning its attention, classes the sounds as noises. The study of noises is essential to the understanding of the qualities of musical instruments, and especially of speech; but their study may well be passed till we more completely understand the nature of the apparently simpler, and much more interesting, musical tones. While actual musical tones may be non-periodic, containing incommensurable partial tones, yet it is probable that the components are individually periodic, and often the entire tone is periodic. We may proceed with the provisional definition that the sensation of tone is caused by a periodic vibration in the air, and to this we are mainly to confine our attention.

The ear, further, receives three classes of sensations from tones, and presumably no more. One of these gives rise to the characteristic of the tone called pitch; this is easily proven to depend upon a very simple condition, that of mere frequency of vibration.

The second property of tone is loudness or intensity, which is not so simple as pitch. For tones of the same pitch, it varies mainly as the energy of vibration, and this is a function of the amplitude of vibration, varying approximately as its square; loudness also varies with pitch, approximately as the square of the frequency. As regards the loudness of what we hear, very much depends upon the individual ear, and, as Professor Sabine has clearly shown, upon the surrounding objects, walls of rooms, etc.

The third property of tone is much the most complicated; it is that characteristic of sounds produced from some particular instrument or voice, by which they are distinguished from the sounds of the same loudness and pitch, produced from other instruments or voices. This characteristic is called timbre, clang-tint, *klangfarbe*, or, best of all, the idea is expressed by the simple English word quality; we shall use the word quality in this specific sense.

With comparatively little practise any one can acquire the ability to distinguish with great ease any one of a long series of musical instruments, even when they all sound tones of the same loudness and pitch. There is an almost infinite variety of tone quality; not only do different instruments have characteristic qualities, but different individual instruments of the same family show more delicate shades of tone quality; and even notes of the same pitch can be sounded on a single instrument with qualitative variations. The bowed instruments, of the violin family, show this ability in a marked degree. But no musical instrument equals the human voice in the richness of qualitative va-

rieties and variations; speech employs these very qualitative varieties to distinguish the letters and syllables.

When we inquire as to the cause of tone quality, since pitch depends upon frequency and loudness upon amplitude, we conclude that quality must depend upon the only remaining property of a periodic vibration, namely, the peculiar kind or form of the motion; or, if we represent the vibration by a curve or wave line, the quality is dependent upon the peculiarities represented by the shape of the wave. There is possible an endless variety of motion for the production of sound, and quality is, therefore, almost infinitely complicated in its causes, as compared with the other two properties of sounds.

There can not be a simpler mode of vibration than that known as simple harmonic motion, which is represented by the wave line called the sine curve; such motion is often referred to as pendular motion. Tuning forks properly constructed and mounted on resonance boxes are shown by analysis to produce vibrations in the air which are single simple harmonic motions; the resulting tones are called simple tones, and their sensation is markedly simple and pure. If several simple tones of different pitches, as from several tuning forks, are simultaneously sounded, they simultaneously excite different systems of waves, which exist as variations in density of the air; the resulting displacements, velocities, and changes in density of the air are each equal to the algebraic sum of the corresponding displacements, velocities and changes in density which each system of waves would have separately produced had it acted independently. There must, therefore, be peculiarities in the motion of a single particle of air which differ for a single tone and for a combination of tones; and in fact the kind of motion during any one period is entirely arbitrary, and may indeed be infinitely various.

The method by which the ear proceeds in its analysis of tone quality was first definitely stated by Ohm, in Ohm's law of acoustics. Helmholtz states this law in the following forms:

> All musical tones, however complex or peculiar in quality, are periodic; the human ear perceives pendular vibrations alone as simple tones, and it resolves all other periodic motions of the air into a series of pendular vibrations, *hearing* the series of simple tones which correspond to these simple vibrations.

Another rendering of this law is:

> Every motion of the air which corresponds to a composite mass of musical tones is capable of being analyzed into a sum of simple pendular vibrations, and to each such simple vibration corresponds a simple tone, sensible to the ear, and having a pitch determined by the periodic time of the corresponding motion of the air.

The separate component tones are called partial tones, or simply partials; that partial having the lowest frequency is the fundamental, while the others are overtones. However, it sometimes happens that a partial not the lowest in frequency is so predominant as to give the main character to the whole sound, and it may be mistaken for the fundamental. If the overtones have frequencies which are exact multiples of the frequency of the fundamental, they are often called harmonics; otherwise they may be designated as inharmonic partials.

In stating his law, in 1843, Ohm says:

> Fourier spread light in our darkness when he brought out (in 1822) his work "La Théorie Analytique de la Chaleur," and so enabled theoretical mechanics to solve the most difficult problems of physics with unparalleled ease.

Fourier had shown in a purely mathematical way, and with no idea of acoustical application, that any given regular periodic function can always be expanded in a trigonometric series of sines and cosines, and for each case in one single way only.

Each sine or cosine term in the series may be considered as representing a single vibration; then in Fourier's series, the successive terms have frequencies which are exact multiples of the first, but the amplitudes and phase differences are arbitrary and can always be found in every given case, by peculiar methods of calculation which Fourier has shown.

So far as Fourier's theorem is concerned this method of analyzing sound vibrations might be merely a mathematical form, not necessarily having any corresponding actual meaning in the sounds themselves. Moreover, in actual musical sounds, many of the important partials are not exact multiples of the fundamental in frequency, that is, they are inharmonic, and with these Fourier's theorem has nothing whatever to do, although Ohm's law still applies to them.

Helmholtz fully demonstrates that the ear unaided can thus analyze tones; he also developed several methods for assisting the ear, chiefly by the use of resonators. His monumental work, "Tonenempfindungen," was referred to by our chairman last year as

> produced by a masterful knowledge of physiology, physics and mathematics, and a scholar's knowledge of the literature of music, remarkable for its breadth, completeness and wealth of detail.

A large part of this work is concerned with the demonstrations of Ohm's law that the quality of a musical sound is dependent upon the particular combination of partial tones which make up the sound under examination. He held that

> Differences in musical quality of tone depend solely on the presence and strength of partial tones, and in no respect on the difference in phase under which these partial tones enter into composition.

A few historical references may be interesting as showing how clearly these ideas were perceived by the earliest investigators.

Descartes (1618) says:

> No musical sound can be heard which does not appear to the ear to be accompanied by the octave above it.

Mersenne (1636) says of Aristotle:

> He seems to have been ignorant of the fact that every string produces five or more different sounds at the same time, the strongest of which is called the natural tone of the string, and alone is accustomed to be taken notice of, for the others are so feeble that they are perceptible only to delicate ears.

Perrault (1680) says:

> Every noise, although apparently simple, is in effect a system and an assemblage of an infinity of partial noises that compose a total, in which no confusion is remarked on account of the affinity that all these partial noises have together.

Sauver (1702) remarks that

> The organ only imitates by the combination of its stops the natural harmony of sonorous bodies.

La Grange and Bernoulli (1760) both state clearly the cause of quality:

> The same single sonorous ray may be moved at the same time by many species of vibrations which do not interfere with each other in any manner; in the place of a node with regard to one species, a segment may be formed with regard to another.

Monge (1800) says that

> Quality is due to the order and number of the vibrations of the aliquot parts of a string, and if the vibrations of these aliquot parts could be suppressed, all strings, of whatever material, would yield tones of the same quality.

Young (1800), describing his experiments for rendering visible the vibrations of a string by means of a ray of light, says:

> According to the various modes of applying the bow an immense variety of orbits are produced; more than enough to account for all the differences of tone by different performers.

Biot (1817) says:

> All sonorous bodies yield simultaneously an infinite number of sounds of gradually decreasing intensity, but the law for the series of harmonics is different for bodies of different forms; it is this difference which produces the particular character of sound called timbre. And may not the quality of each particular substance, wood or metal, for

instance, be due to the superior intensity of one or another harmonic?

Many other quotations might be given of opinions expressed by Rameau, Chladni, Wheatstone and others; but enough has been said to show that the ideas as to quality were well understood before Ohm put forth his law, which is almost misnamed.

Helmholtz (1862) defended and developed Ohm's theorem, and gave elaborate proof of it, chiefly by the use of resonators. Melde (1864) made visible, by his beautiful tuning-fork monochord, the simultaneous existence of two or more harmonic vibrations in a string. Koenig (1872) showed the simultaneous coexistence of two sets of waves in the same organ pipe by means of his manometric flames.

The theories of Ohm and Helmholtz seem so simple that they have generally been accepted as expressing the whole physical condition, and few investigators have successfully combated them. Seebeck (1844) argued that the quality of tone must be decided by the ear, and he concluded that the definition of a simple tone given by Ohm is too limited; he believes that other forms of vibration besides the pendular are capable of giving the sensations of a single simple tone, and that simple tones may have different qualities among themselves. Seebeck greatly improved the siren, and used it to produce the fundamental and partial tones with which he experimented. Helmholtz admits the experimental results of Seebeck, and after extended argument, he claims that Seebeck did not give proper attention to the hearing of the partials.

Another investigator to oppose Helmholtz was Koenig; he was not satisfied with the statement as to the cause of tone-quality. Koenig invented the wave siren, a very beautiful piece of demonstration apparatus, with which he showed that quality is not accounted for solely by the presence and relative intensity of the partials; but that phase is a factor too important to be left out of account. If changes in the number and intensity of the partials give rise to such differences in quality as we observe in instruments belonging to different families, Koenig says the changes in the difference of phase for the same partials are competent to produce differences of quality at least as sensible as those which are noticed in instruments of the same kind.

Helmholtz says distinctly that if we disregard the noise of rushing wind, the proper musical quality of the tone produced by blowing over the mouth of a bottle is really the same as that produced by a tuning fork; and that the tone of a flute, which according to Helmholtz is practically devoid of over-tones, is the same as that of a tuning fork. Since we agree to some extent with Seebeck, that tone quality must be decided by the ear, we hesitate to adopt the conclusion that the bottle and the fork both give simple tones of the same musical quality.

When this address was first thought of, it was hoped that some conclusions might be reached regarding this general question. But, for reasons referred to later, it seems best to limit our further consideration to certain particular instances, about which it is believed some definite conclusions can be drawn.

Perhaps the points to be investigated will be most clearly presented by a somewhat personal statement of the incidents that led to this enquiry.

In connection with the study of the flute as a musical instrument there arose the question which may be specifically stated:

Is the tone quality of a flute, the tube of which is made of gold, superior to that of a similar flute having a tube of silver or of wood? If there is a difference, what is its cause?

Probably many will be inclined at once to dismiss the subject as not a question,

claiming that there can be no difference in such a case, due to material. The writer was of this opinion at one time. When visiting the establishment of an eminent London flute maker, in 1900, he was shown several flutes which were tested. One instrument seemed of such unusual excellence that the remark was made that it was certainly of the finest quality of any that had ever been tried. After the instrument had been returned to its case, the writer enquired whether it would be possible, at some time in the visit to London, for him to see one of the few gold flutes which had been made, and which were celebrated for quality. The reply was startlingly unexpected, for the maker said, with evident satisfaction, that the flute just played was of gold! It had been prepared for the Paris Exposition, but was not being exhibited, as the English exhibits had been largely withdrawn because of some French caricatures of Queen Victoria. It may be well, also, to add that the flute had been examined in dim artificial light, the color thus escaping notice. However, the incident carried conviction to the writer, as very few tests could have done.

As further justification for considering this question, several quotations will be given showing the great difference of opinion among those who should speak with authority.

Each kind of wind instrument, except the flute, has always been made of its own proper kind of material; there are two large classes, the wood-wind and the brass-wind of the orchestra. Each group has its distinct tone quality, which is generally considered as due to the method of tone production, while the material is regarded as a matter of mechanical convenience. The flute is classified as a wood-wind instrument.

Formerly flutes were usually made of wood, though in 1806 flutes of glass were patented by Laurent, of Paris, the advantages claimed being, not tone-quality, but freedom from checking, changes of bore, and leakage. Ivory has been used for small flutes, and parts of large flutes, mainly for the sake of appearance. In 1847 Theobald Boehm, of Munich, a Royal Bavarian court-musician, who had, in 1832, invented a new system of fingering and key construction, made elaborate experiments on the bore, size of holes, and material. These experiments had an academic relationship, for they were carried out under the guidance of Dr. Carl von Schafhäutl, an eminent professor in the University of Munich, who was a life-long personal friend of Boehm. Boehm experimented with hundreds of tubes, and our interest lies in the fact that he introduced with great success cylindrical tubes of hard-drawn silver, though wood tubes were also used. There at once arose a controversy as to the relative merits of various materials, which still rages.

Besides being one of the world's greatest artists and a composer of ability, Boehm maintained one of the most celebrated flute manufactories, and made hundreds of flutes of the highest excellence; instruments made in his lifetime are to-day valued above all others, as the old Italian violins are valued above modern instruments. Near the end of his career, in 1871, he published a book giving the results of his sixty years of experience, in which he says:

> The greater or less hardness and brittleness of the material has a very great effect upon the quality of tone. Upon this point much experience is at hand. Tubes of pewter give the softest, and at the same time the weakest, tones; those made of very hard and brittle German silver have, on the contrary, the most brilliant, but also the shrillest, tones; the silver flute is preferable because of its great ability for tone modulation and for its unsurpassed brilliancy and sonorousness; compared with these the tones of flutes made of wood, sound literally wooden.

Directly against these opinions of Boehm we may place the equally authoritative one of Victor C. Mahillon, of Brussels, the head of the celebrated musical instrument manufactory, and the Curator of the Museum of Instruments of the Belgian Royal Conservatory of Music—containing one of the most celebrated collections of musical instruments in the world. Mahillon has devoted his life to the study of musical instruments, and is recognized the world over as an eminent authority. In his treatise, "Elements d'Acoustique, musicale et instrumentale," one of the best works on the acoustics of musical instruments, he says:

Theobald Boehm was the first, we believe, to try to construct a flute upon scientific principles, using a cylindrical tube, with rationally placed holes; it was he who first tried to explain the division of the air column of the tube. . . . It is to be regretted that this celebrated reformer of the flute was not able to grasp the principle, resulting moreover from his own theory, that the air is the only vibrating body in the flute, as well as in all other wind-instruments. It would have been better had he not written the following lines, which in our opinion, disfigure all of his work.

Mahillon then quotes Boehm's opinions given above, and continues:

One would almost refuse to believe, if it were not written, that a man of the standing of Boehm, who had revolutionized, from the foundation, the principles which had existed for ages in the construction of flutes, was not able to release himself completely from such prejudices; nevertheless, he held to this one blunder.

In another place, Mahillon says:

This error is shared in by nearly all artists who play wind instruments. The one who plays a brass instrument will say that the thinner the walls the more easy will be the production of tone; the bassoonist is persuaded that all the vibrations of his instrument exist in the material of the mouth piece.

He describes the opinion of the clarionetist and flutist at length, and continues:

Who does not know the brilliant sound of the cavalry trumpet? It would seem that if this same brilliancy were produced by an instrument constructed wholly of wood, that this error whose existence we regret, would disappear forever. But it is not so. For more than ten years, we have had occasion to make heard, almost every day, an instrument constructed by Mr. C. Mahillon; it possesses the exact proportions of a cavalry trumpet, and gives exactly the same brilliancy as the instrument of brass, so that it is impossible to distinguish the one from the other. How much trouble professors might spare their pupils, if, being inspired by the revelations of science, they would content themselves with teaching principles, and abandon the prejudices which pass every day from master to pupil.

Albert Lavignac, professor in the Paris Conservatory of Music, in his book, "Music and Musicians," published in New York in 1899, says:

First we have to notice that the sonorous body is the column of air contained inside the tube, whose metal, wood, or other material, has no office whatever, except that of determining the form and dimensions of the mass of air imprisoned within it, which is itself, and itself alone, the vibrating body. The recognition of this fact is of the highest importance in understanding the subject.

Lavignac then describes the experiments of Mahillon with the wood trumpet, and other experiments of the same import by Sax, the instrument maker of Paris, with brass clarionets; he also refers to pasteboard organ pipes and other instances, which support his theory.

The gentlemen quoted are by no means alone in their opinions. The writer has occasionally mentioned to some of his scientific friends that he sometimes wondered whether the tone of a flute is affected by the material of its tube. Many times the answer has been: "Of course, *you* think it is not."

In direct opposition to the experiments of Mahillon and Sax are those of Schafhäutl (of the University of Munich), who throughout his life made many researches on acoustical subjects, being influenced, no doubt, by the problems which his friend

Boehm was trying to solve. He is the author of many papers, which appeared in the *Annalen der Physik*, and in various scientific and musical journals. One of his papers, published in 1879, is entitled: "Is the dogma of the effect of the material out of which a wind-instrument is made, upon the tone of the same, a fable?" Schafhäutl quotes at length a sarcastic statement which begins by saying:

> A fable, the more remarkable since it is always discussed, is that the material of which a wind-instrument is made, has an influence upon the material of the same; that this is not so rests upon incontrovertible acoustical laws, about which there should be absolutely no more discussion.

Schafhäutl then says:

> From the student of nature, such an oracular speech in the name of science would certainly win a laugh.

He proposes to allow nature to speak for herself upon this interesting question. He then describes with great detail how he had made seven cavalry trumpets with internal dimensions all exactly alike; of thick brass, thin brass, lead, gypsum, and three of paper of different thicknesses; they were placed side by side on a convenient stand, and were blown by a most skillful professional trumpeter. He says:

> What a difference in the tone quality! The most brilliant tone was given by the trumpet of brass 0.85 mm. thick. The tone of the trumpet of lead was heavy and dull, while the tone of the paper trumpets was papery and excited general laughter.

He describes many other experiments and opinions about reed instruments, violins, flutes, organs, the human voice, etc. The study of this work led the writer to repeat some of Schafhäutl's experiments and to try others with organ pipes, the results of which will be given in some detail.

For a model an open organ pipe of wood was chosen, of the style usually supplied by Koenig for acoustical experiments. This pipe gives the tone $G_2 = 192$ complete vibrations—this is violin G, below middle C; the pipe is 5.8 cm. wide, 7 cm. deep, 78 cm. long and has walls 1 cm. thick. Four pipes having exactly the same internal dimensions as this wood pipe were made of common sheet zinc, the metal being about 0.5 mm. thick. Upon blowing one of the zinc pipes, the unexpected result was obtained that its pitch is more than two semi-tones of the musical scale lower than that of the wood pipe of the same dimensions; its pitch was found to be 164, and that of the other zinc pipes was nearly the same. The pipes are always blown on a windchest, under moderate pressure—2½ to 3½ inches by the water gauge—which is automatically controlled.

While the zinc pipe is clearly sounding its fundamental tone, if it is very lightly touched on opposite sides by the thumb and finger, it immediately speaks the first overtone very clearly with no perceptible admixture of the fundamental; upon removal of the fingers the sound returns to the fundamental. The overtone thus obtained is not harmonic, its frequency being 2.06 times that of the fundamental; however, the pitch of both the fundamental and the overtone can be varied several vibrations per second by grasping the pipe in the hand and varying the pressure of the grasp.

If the pipe is firmly grasped in both hands, just above the mouth, it speaks a mixture of the fundamental and the second partial, just mentioned and also a third partial whose frequency is 2.66 times that of the fundamental. By increasing the pressure of the hands on the outside of the pipe, the first and second partials become weaker, while the third becomes stronger till it is the real tone of the pipe; it is approximately the tone Bb, a fourth above the octave of the fundamental. These results are so conspicuous as to be almost startling, caused by the unmusical sound of the inharmonic partials; the tone quality

varies as much as from a flute to a tin horn.

One of the zinc pipes was placed inside of a large pipe of zinc to form a double-walled pipe, with spaces 2 cm. wide between the walls; the outer wall was attached to the inner one only at the extreme bottom on three sides, but just above the upper lip plate on the front side. Attaching the outer pipe did not alter the pitch or quality in any noticeable degree. The double-walled pipe gives a full fundamental tone, $F_2 = 164$, without conspicuous overtones.

While the pipe is sounding continuously, water, at room temperature, is allowed slowly to run into the space between the walls. As this space is filling, the tone of the pipe changes conspicuously thirty or forty times; a few of these changes will be noted. When the water is 5 cm. above the lower lip, the pitch rises by 2 vibrations per second; when the water is 10 cm. high, the fundamental tone breaks, and the first overtone is clearly heard; at 11 cm. the fundamental is almost inaudible, the first overtone being loud; at 14 cm. the fundamental alone is heard, but with a pitch 6 vibrations sharper than at first. As the water rises the pitch begins to fall, and the overtone reappears, till, at a height of water of 28 cm., the two tones are both very distinctly heard, the fundamental having a pitch of 164 F_2, the same as at the beginning, and the overtone a pitch 2.13 times as great, about that of the tone $F_3\sharp$. At a height of water of 29.5 cm. the overtone is heard alone, at 31.5 cm. the fundamental only is heard; while at 33.5 cm. the two tones are mixed and are both clearly sounded. These alternations are again repeated, and as the water rises to a height of 46 cm. the fundamental begins to flatten, till, at 57 cm., its pitch is 158, that of the tone E_2, a semi-tone lower than at first. As the pitch of the fundamental falls, that of the overtone rises, and when the water stands 69 cm. high, the fundamental has a pitch of 160, the overtone 400, the ratio is 2 : 5, or the tones, instead of being an octave apart, are an octave and a third. The actual sounds are E_2 and $G_3\sharp$, and the two sounds from the one pipe are each as clear and distinct as the sounds from two separate pipes, as actual comparison has many times proved to various observers. As the water rises through the remaining 9 cm., there are several changes in quality; when the space is full of water the overtone, though present, is less intense and is not in such good tune.

This pipe, which has the dimensions of a wood pipe giving the tone G, has, when empty, the pitch F, and when filled with water the pitch is E; during the filling the pitch varies more than a semi-tone, first rising and then falling, while the changes in the quality of the tone are so astonishing that they must be heard to be appreciated.

The pipe has been filled with sand, and it shows the same series of changes, though some of the tones seem to be more deadened than with the water filling, and it does not seem to be quite so sensitive to slight variations.

(Some photographic records of the variations in the sound waves coming from this pipe, and the pipe itself will be exhibited in another communication to the program of this meeting. The photographs show the distinctness of the changes that occur.)

It is, of course, well known that the pitch and even the quality of a pipe are influenced by the thickness of wall and condition of the inner surface; but that the properties of the pipe should be so profoundly altered by even slight changes entirely outside of the pipe was wholly unexpected, even with a pipe of the construction described. After the demonstration of these effects, one will surely admit that the quality of a wind-instrument may be affected by the material of its body to the comparatively limited extent claimed

by the player. That the flute is more susceptible to this influence than other instruments is due to the fact that its tube is only from 0.2 to 0.3 mm. thick, that is, half as thick as the zinc walls of the experimental pipe. The cylindrical shape of the tube gives a mechanical stiffness which largely prevents the transmission of influences through the walls; nevertheless, it is conceivable that the presence or absence of a ferrule or of some support for a key might cause the appearance or disappearance of a partial tone, or put a harmonic partial slightly out of tune. (The idea of experimenting with a flute of rectangular cross-section occurred too late to be made use of at this time.)

The traditional influences of the different metals on the flute are consistent with the experimental results obtained from the organ pipe. Brass and German silver are usually so hard, brittle and stiff as to have but little influence upon the air column, and the tone is said to be hard and trumpet-like. Silver is heavier and softer, and adds to the mellowness of the tone. The much greater softness and density of gold adds still more to the soft-massiveness of the walls, giving an approach to the organ pipe surrounded by water, and permitting a greater influence of the walls upon the tone, and increasing the richness of tone by augmenting the fullness of the partials, as was the case with the organ pipe. That the partials from the gold flute are actually fuller than from other, is proved by the photographic comparisons of wave forms which are referred to in another communication.

Mere massiveness of the walls does not fulfill the desired condition; a heavy tube, obtained from thick walls of brass, has such increased rigidity as to produce an undesirable result. The walls must be thin, soft and flexible, and be made relatively massive by increasing the density of the material. A tube of pure platinum would best fulfill these conditions; a report upon the influence of such a tube may be made later.

The gold flute tube and the organ pipe surrounded with water are, no doubt, similar to the longer strings of the pianoforte which have such rich quality; these strings are wound or loaded, making them massive, while the flexibility or "softness" is unimpaired. The organ pipe partly filled with water is like a string unequally loaded, its partials are out of tune and give a freak tone. The flute, unfortunately of necessity, is unequally loaded by its key mechanism, and this no doubt accounts for the fact always noticed by players, that certain tones are full while others are poor or dull in quality, or are liable to shrillness; the skillful player covers these defects by his art. This opinion is confirmed by the fact that the tone of flute tubes having no holes or keys is influenced by the manner of holding the tube in the hands; certain overtones are difficult to produce till the points of support of the tube have been shifted.

(The question has been answered to the writer's complete satisfaction by actual musical trials, extending over four years, with flutes of wood, hard rubber, glass, brass, German silver, silver and gold. The gold flute is, beyond all doubt, distinctly superior; its tone may be described as full, rich, less shrill when sounded loudly, and more liquid; the silver flute is more delicate, and certainly simpler in quality, which manifests itself as shrillness in the loud and high tones.)

The quantitative and photographic investigation of this question is not complete, but one result of general application seems conclusive. Perhaps the theory of Helmholtz has been very generally accepted, that all tones of the same quality, that is, belonging to the same register of any given instrument, have a characteristic set of harmonics, the proportional intensities of

which remain constant. Visual and photographic observation of the wave forms from many instruments shows that the overtones are certainly not harmonic in the sense commonly understood, and, moreover, the different notes in the scale of any one instrument are not similar in their composition. While a tone is being given with no variation that the ear detects, the partials are seen to be rapidly varying in phase, or intensity, or both. A slight change in the manner of blowing a wind instrument, which to the ear results merely in a change of loudness, completely alters the form of the wave. Instead of a characteristic series of harmonics, it seems that each instrument possesses rather a characteristic tone or tones, which is of constant pitch for all notes of its scale. This theory has been recently advanced by Meissner, from experiments with the phonograph. Such a characteristic tone for the flute would seem to be consistent with the rather anomalous conditions imposed by the stopper in the head-joint of the instrument.

The inadequacy of the former theory is clearly shown by the failure of many attempts to synthetically reproduce the characteristic tones of orchestral instruments, such as those by Helmholtz, Koenig and more recently by the Telharmonium.

A complete reply to the second part, "Why," of the question propounded for consideration has, by no means been given; but the first part of the question, we feel, has been conclusively answered: the effect of material upon tone quality of wind instruments certainly is not a fable.

DAYTON C. MILLER
CASE SCHOOL OF APPLIED SCIENCE

REPORT OF COMMITTEE ON STANDARDS OF AMERICAN UNIVERSITIES[1]

THE Committee on Standards of American Universities begs leave to report as follows:

[1] Amended and adopted by the National Association of State Universities, Washington, D. C., November 17, 1908.

The committee originally was appointed at a session of this association in Washington, D. C., November 13, 1905, and consisted of Presidents Bryan, of Indiana, James, of Illinois, and MacLean, of Iowa, Chairman. The resolution under which the committee was appointed reads:

> That a committee be appointed that shall report later to this body upon standards for the recognition of American universities and upon standards for the recognition of the A.B. degree and higher degrees.

The committee was unable to meet in 1905–6. The chairman presented a memorandum for a partial report at the session of the association, November 12–13, 1906, in Baton Rouge, La., and the committee was continued. At a meeting of the association in 1907, the committee asked for further time. The request was granted and at the special meeting of the association in Chicago in February, 1908, President Baker, of Colorado, was added to the committee. The committee has had several extended sittings and unites in the following statements and recommendations:

Your committee believes that there are certain clearly marked tendencies or forces at work in our American society toward a development, at no distant date, of a typical institution of learning, which we may not improperly call the Standard American University.

This institution will, for an indefinite time, include as an important part of its organization what we may call a Standard American College, with a four-year curriculum, with a tendency to differentiate its parts in such a way that the first two years shall be looked upon as a continuation of, and a supplement to, the work of secondary instruction, as given in the high school, while the last two years shall be shaped more and more distinctly in the direction of special, advanced or university instruction, rising gradually into the advanced work of the graduate school.

The Standard American University will also include as a distinct department the graduate school or philosophical faculty.

It will also include as organic parts of the institution in its fully developed form, vari-

ous professional schools such as law, medicine and engineering.

Present tendencies point, in our opinion then, to a definite differentiation in the work of the college at the close of the sophomore year toward university work in the real sense. If these views are just, we suggest the following formulation of principles underlying the organization of such an institution and we may define the Standard American University to be an institution: (1) Which requires for admission the completion of the curriculum of a standard American high school with a four years'[1] course, or in other terms, the completion of a course which will enable the pupils to offer not less than fourteen five-hour units, or equivalent; (2) which offers in the college of literature and science two years of general or liberal work completing or supplementing the work of the high school; (3) which offers a further course of two years so arranged that the student may begin work of university character leading to the bachelor's degree at the end and reaching forward to the continuation of this work in the graduate school or the professional school; (4) which offers professional courses, based upon the completion of two years of collegiate work, in law, or medicine or engineering; (5) which offers in the graduate school an adequate course leading to the degree of doctor of philosophy.

It is recommended that this association recognize any institution, in whole or in part, doing work of this grade as, in so far, doing work of university quality.

In recommending that university work begin with the junior year of the college and that the professional schools be based on the first two years of college, the report is in line with present tendencies. It is in accord with the growing belief that the work of the last two years of college should be organized into groups that aim at more definite results, and lead to greater efficiency. But this is only the first of many problems. We are facing questions of the time beyond the junior year for attaining the Ph.D. degree, of adjusting the scheme of counting the last two years toward both arts and professional degrees, of the place of the A.B. degree, of the age when the period of general education should end, and of a possible reorganization of elementary and secondary education. But these questions are not ready for solution and hardly belong to the work of the committee at the present time.

In accordance with the foregoing definition of the Standard American University, it is recommended that the following standards be set up:

1. *Time Requirement for the Bachelor's Degree.*—Not less than sixty year-hours, or twelve units, of collegiate work shall be required for the bachelor's degree.

2. *Qualifications of Teachers.*—It is expected that the teacher in the high school shall have the bachelor's degree, or show evidence of equivalent attainment, and it is recommended that he have the master's degree. As a rule, the professors of all ranks in the collegiate work shall have the degree of doctor of philosophy, or its equivalent. The professors giving instruction in graduate work are expected to show, in addition to the possession of a doctor's degree, or its equivalent, their scholastic ability by successful research and publication, and above all, they must have demonstrated that they have power as teachers to inspire the students with zeal for research. Indeed, it is understood that all the teachers should possess the power of imparting knowl-

[1] The definitions of *standards* in terms of time are used as a matter of convenience, but there shall be due opportunity in individual cases to show equivalents. In the definitions of *units* for collegiate entrance requirements, it is recommended that those now current in the North Central Association of Colleges and Secondary Schools, the Association of Colleges and Preparatory Schools of the Middle States and Maryland, the New England Association of Colleges and Preparatory Schools, the Association of Colleges and Preparatory Schools of the Southern States, the College Entrance Examination Board, the New England College Entrance Certificate Board and the National Conference Committee of the Associations of Colleges and Preparatory Schools, and those formulated by associations of experts, and accepted by the above bodies, be recognized.

edge and of character building. In addition, the professors in the professional schools should give evidence of doing investigative work and those in technical schools, evidence of the power of practical research.

3. *Institutional Facilities.*—(1) There should be adequate general and departmental libraries, with (*a*) sufficient number of duplicate books for purposes of undergraduate instruction, (*b*) where graduate work is offered, books, monographs and other material for purposes of research. (2) There should be modern laboratories[2] and apparatus, with (*a*) sufficient supervision for undergraduate teaching, (*b*) where graduate work is offered, research laboratories.

4. *Time Units for Degrees.*—Institutions providing for advanced work shall require three years or nine five-hour units[3] from the beginning of the junior year for the degree of master of arts, or five years or fifteen five-hour units for the degree of doctor of philosophy, and with work in residence.[4]

5. *Scope of Curriculum.*—To be a standard university an institution shall be equipped to give instruction leading to the degree of doctor of philosophy in at least five departments, according to the standard prescribed in this report, and shall have at least one university professional or technical school. The term *university professional* or *technical school* shall not be applied to any professional or technical school that does not require the two years' collegiate training for admission.

Your committee further recommends as follows:

Provision for Recognition of Other Institutions.—Provision shall be made whereby institutions other than state universities may be freely welcomed to adhere to the standards set up by this association.

Committee on Standards

1. There shall be a standing committee on standards of five members, of which the honorary vice-president of this association (the United States Commissioner of Education) shall be one. The committee on standards may invite into conference representatives of other educational organizations interested in formulating standards.[1]

2. When institutions within or without the association seek to adhere to the standards, said committee shall have the power to recommend to this association for recognition, institutions meeting these standards and may, after report to this association and its approval, issue certificates to institutions, to departments and even to individual instructors.

3. The committee may employ assistance upon the approval of the executive committee, the compensation for such assistance, together with necessary traveling expenses, to be paid from a fund created for the purpose, raised by apportionment among the members of this association in accordance with the sum expended by each institution for salaries.

4. The committee or their representative

[2] In the use of the term *laboratories*, not only those for the material sciences with opportunity for proper field work are included, but also museums and proper laboratories for the historical sciences and philosophy.

[3] The unit in the high school is reckoned usually from a period of forty minutes, with twenty periods in a week. The units in the college or university are reckoned from a period of fifty or fifty-five minutes, with fifteen periods in a week, the differences in length of periods and in number of periods a week being due to the maturity or training of the student.

[4] The units shall not necessarily be schedule hours, but their equivalent, and shall include credit for research and thesis work. It is of course understood that from the beginning of the junior year, there is the adoption of a group system suggested by the honor schools in English universities, or the separate faculties in the German universities, and that the kind of instruction contemplates investigation—in short, science with power—as the purpose. It is the intent that the cultural atmosphere shall pervade the work of the student who begins specialization and that something of the spirit of discovery and the earnestness it brings shall affect the cultural temper.

[1] Committee is made up of the following members: President Jacob Gould Schurman, *chairman, ex-officio;* Dr. Elmer E. Brown, United States Commissioner of Education, *ex-officio;* President William Lowe Bryan, President James H. Baker, President Edmund J. James, President George E. MacLean, *secretary.*

may, when invited, visit an institution applying for recognition, the expense of such visitation to be borne by the institution concerned.

5. In making recommendations as to institutions, the committee on standards shall give great weight to the character of the curriculum, the efficiency of instruction, the scientific spirit, the standard for regular degrees, conservatism in granting honorary degrees, and the general tone of the institution.

6. This committee shall further be charged with the duty of correspondence with institutions and governments at home and abroad to gain proper recognition of graduates and students from these recognized institutions, departments and individuals.

7. The committee on standards shall report further upon standards and classification and shall cooperate as far as possible with a similar committee of the Association of American Universities.

Publication of Standards and List of Institutions.—This association shall publish the standards that have been adopted and, from time to time, the list of institutions adhering to them.

William Lowe Bryan,
James H. Baker,
Edmund J. James,
George E. MacLean, *Chairman, Committee*

THE SEVENTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY

The American Committee for the Seventh International Congress of Applied Chemistry, which meets in London, from May 27 to June 2, 1909, has been completed and a list of the members follows. The fee for membership for men at the approaching meeting is one pound and for women fifteen shillings. It is suggested that subscription for membership be sent to the chairman of the American committee or to chairmen of the sub-sections, and that five dollars be sent for men's memberships in order to cover the necessary expense for postage, etc., which has been and will be incurred. The chairman of the committee or the chairmen of the sub-committees will undertake to forward subscriptions to the London committee, or members may send their checks to Mr. Thos. Tyrer, treasurer, 10 Cromwell Crescent, London, S. W., England. In the latter case it is requested that notice be sent to the chairman of the American committee. Titles of papers, together with abstracts, should be sent first to the chairman of the section to which the papers belong, and he will transmit them to the chairman of the American committee for entry and transmission to London.

H. W. Wiley

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All subscriptions exceeding one dollar in amount have been individually acknowledged.

CHARLES B. DAVENPORT,
Secretary

THE COLUMBIA UNIVERSITY DARWIN LECTURES

A SERIES of lectures on "Charles Darwin and His Influence on Science," will be given at Columbia University on Friday afternoons, from February 12 to April 16, 1909, in 309 Havemeyer Hall, at 4:10 P.M., with the exception of the introductory lecture, which will be given at 11:10 A.M., on February 12, the one hundredth anniversary of Darwin's birth. The lectures, which are open to the public, are as follows:

February 12—"Darwin's Life and Work," by Henry Fairfield Osborn, Sc.D., LL.D.

February 19—"Terrestrial Evolution and Paleontology," by William Berryman Scott, Ph.D.

February 26—"Darwin's Influence on Zoology," by Thomas Hunt Morgan, Ph.D.

March 5—"Darwin in Relation to Anthropology," by Franz Boas, Ph.D.

March 12—"Darwin's Contribution to Psychology," by Edward Lee Thorndike, Ph.D.

March 19—"Darwin's Influence on Botany," by Daniel Trembly MacDougal, Ph.D.

March 26—"Darwinism and Modern Philosophy," by John Dewey, Ph.D., LL.D.

April 2 (date subject to change)—"Cosmic Evolution," by George Ellery Hale, Sc.D.

April 16—"Darwinism in Relation to the Evolution of Human Institutions," by Franklin Henry Giddings, Ph.D., LL.D.

SCIENTIFIC NOTES AND NEWS

DR. HENRY F. OSBORN has been elected president of the New York Zoological Society.

DEAN FRANK OLIN MARVIN, of the School of Engineering of the University of Kansas, was elected president of the Sigma Xi scientific society at the recent Baltimore meeting.

DR. S. A. FORBES has tendered his resignation as professor of zoology in the University of Illinois, which position he has held since 1884. The resignation is to take effect on September 1, 1909. He will remain as director of the State Laboratory of Natural History and state entomologist.

DR. CHARLES ROCKWELL LANMAN, professor of Sanscrit in Harvard University, has been elected a corresponding member of the Institute of France in the Académie des Inscriptions et Belles-Lettres.

DR. WILHELM WALDEYER, professor of anatomy at Berlin, has been elected a foreign member of the Stockholm Academy of Sciences.

THE University of Berne has conferred the honorary degree of Ph.D. upon the Rev. W. A. B. Coolidge, M.A., fellow of Magdalen College, Oxford, in recognition of his works on Swiss history and geography.

M. FREUNDLER has been elected general secretary of the Paris Chemical Society in succession to M. Béhal.

MR. STANLEY FIELD, nephew of Marshall Field, who founded the Field Museum of Natural History, Chicago, and in his will left a bequest of $8,000,000 to the institution, has been elected president in succession to Mr. H. H. Higginbotham.

THE board of regents of the University of Kansas has appointed Professor H. P. Cady, of the department of chemistry, to be official weather observer to carry on the work begun by the late Dr. Snow forty years ago.

THE Carnegie Institution of Washington has made a grant of $3,200 to Professor E. C. Case, of the University of Michigan, for the preparation of two monographs upon the Permian reptiles of North America. Four years ago a grant from the same source of $1,300

was made, and as a result Professor Case published the monograph entitled, "Revision of the Pelycosauria of North America," which has been reviewed in this journal.

Mr. Taft left for Panama on January 25 on the cruiser *North Carolina*, accompanied by the following engineers: Frederick P. Stearns, Boston; John R. Freeman, Providence, R. I.; James Schuyler, Los Angeles; Isham Randolph, Chicago; Henry R. Allen, Chicago; A. P. Davis, Washington, D. C., and Allen Hazen, New York.

Dr. Ellsworth Huntington, instructor in geography at Yale University, will leave New Haven on February 10 for an extended scientific trip in Palestine and Asia Minor.

Mr. Frank A. Perret, who contributed an article on "Some Conditions affecting Volcanic Eruptions" to the issue of Science for August 28, 1908, is at present engaged in investigating the conditions of the Calabrian earthquake.

The Research Club of the University of Michigan will celebrate the Darwin centennial on February 17. The president, Professor Wenley, of the department of philosophy, will give the eulogy; Professor Reighard, of the department of zoology, will speak on "Darwin's Contribution to Zoology"; Professor Case, of the department of geology, on "Darwin's Contribution to Geology"; Dr. De Leng-Hus, of the department of botany, on "Darwin's Contribution to Botany"; and Professor Pillsbury, of the department of philosophy, on "Darwin's Contribution to Psychology." Further, in conjunction with the Michigan Academy of Science and the Society of Sigma Xi, the club will hold a public commemoration meeting on April 2, when the address will be delivered by Professor Scott, of Princeton University.

In addition to lecturing at the Sorbonne, Paris, and at the University of Oxford, President Roosevelt has consented to give a lecture before the students and faculty of the University of Berlin in May, 1910.

During the meeting of the Association of American Universities recently held at Ithaca, President Charles R. Van Hise, of the University of Wisconsin, lectured before the Cornell Chapter of Sigma Xi on "The Conservation of our National Resources."

Professor T. A. Jaggar, Jr., lectured before the Society of Arts of the Massachusetts Institute of Technology on January 21 on "The Scientific Aspects of the Messina Earthquake."

Dr. George H. Shull, of the Station for Experimental Evolution, Cold Spring Harbor, gave an illustrated lecture in the Friday Evening Course of Clark College on January 15, on "Plant Breeding, Economic and Scientific."

Mr. H. E. Ashley, assistant chemist in the Technologic Branch of the United States Geological Survey, read recently a paper before the Columbus Section of the American Chemical Society embodying his recent researches on colloids in clays.

On Friday evening, January 15, Dr. W. R. Brooks, of Hobart College, delivered a lecture on "Other Worlds than Ours" before the Stanford Scientific Society. On February 5 Dr. Robert T. Morris, of New York City, is to lecture before the same society on "A Canoe Trip to Hudson Bay."

The following tablet was recently placed in Barney Hall, of Denison University, in honor of C. L. Herrick, who for many years was professor of geology and natural history in this institution:

CLARENCE LUTHER HERRICK

1859 1904

FOUNDER OF THE
DENISON SCIENTIFIC ASSOCIATION
BULLETIN OF THE SCIENTIFIC
LABORATORIES
JOURNAL OF COMPARATIVE NEUROLOGY
A TRUE TEACHER

A committee has been formed to erect a monument in honor of E. J. Marey, the eminent physiologist. Subscriptions may be sent to M. Carvallo, at the Institut Marey, Parc des Princes, Boulogne-sur-Seine.

Brigadier General William Price Craighill, past president of the American Society of Civil Engineers, died at Charleston, W. Va., on January 18, at the age of seventy-five years.

DR. CHARLES DENISON, a specialist in the treatment of tuberculosis, died at his home in Denver, Col., on January 10.

CLAXTON H. GUILBEAU, professor of zoology at the Louisiana State University, died on January 16, 1909. He was a graduate of the same institution, and had been in charge of the zoological department for several years. Since 1906, he had been director of the Gulf Biologic Station. Owing to heavy university work, he was unable to carry on as much research work as he was ambitious of doing. In summer work at Cornell, he investigated the froth production of the "Spittle Insects," on which he published a paper in the *American Naturalist* for December, 1908. At the time of his death, he had been engaged for several months investigating the parasites of *Plusia brassica*, confirming the results of French investigators as to the development of many insects from a single egg. Unfortunately this work was left in such a stage that it will be impossible to bring it together for publication.

SURGEON-GENERAL JOHN EDWARD TUSON, a retired officer of the Indian Medical Service, the author of numerous contributions to medical science, died at Eastbourne, on December 24, at the age of eighty years.

DR. R. ENGLÄNDER, professor of mechanical engineering in the Vienna Technical Institute, has died at the age of fifty-nine years.

THE death is announced of Dr. A. Grigorief, for twenty years secretary of the Imperial Russian Geographical Society.

THE Darwin anniversary addresses delivered on Darwin Day before the American Association for the Advancement of Science have all been assembled, and will be published at an early date by Messrs. Henry Holt & Company. The title of the volume will be "Fifty Years of Darwinism, Modern Aspects of Evolution and the Various Biological Sciences, Centennial Addresses in Honor of Charles Darwin before the American Association for the Advancement of Science, Baltimore, Friday, January 1, 1909."

AT a meeting of plant pathologists called at Baltimore, December 30, 1908, in connection with the meeting of the American Association for the Advancement of Science, Professor A. D. Selby, of the Ohio Experiment Station, was elected temporary chairman, and Mr. Donald Reddick, temporary secretary. The temporary committee, appointed at Washington, on December 15, consisting of C. L. Shear, Donald Reddick and W. A. Orton, presented its report recommending that an organization of American plant pathologists be perfected. The report of the committee was accepted and temporary organization was effected by the unanimous election of the following officers: *President*, Dr. L. R. Jones, Vermont Agricultural Experiment Station; *Vice-president*, Professor A. D. Selby, Ohio Agricultural Experiment Station; *Secretary-treasurer*, Dr. C. L. Shear, U. S. Department of Agriculture; *Councilmen*, Professor J. B. S. Norton, Maryland Agricultural Experiment Station; Dr. B. M. Duggar, Cornell University Agricultural Experiment Station. The five officers elected form a council which is to consider and make recommendations in regard to all questions relating to the permanent organization, policy and affiliation of the society. The next meeting will be called at such time and place as may be decided by the council.

THE calendar of the botanical seminar of the University of Nebraska for the present year contains the titles of forty-six papers to be presented at twenty-two meetings to be held during the present academic year. Among the meetings is a Darwin Anniversary on February 12, of which the program is as follows:

Mr. Pool: "Pre-Darwinian Evolution."

Dr. Walker: "The Life of Darwin."

Professor Ward: "Darwin as a Zoologist."

Professor Barbour: "Darwin and the Geological Record."

Professor Bessey: "Darwin's Contributions to Botany."

Professor Wilcox: "Darwin's Contributions to Plant Physiology."

THE note in regard to the Winnipeg meeting of the British Association for the Advancement of Science printed in SCIENCE for January 15 should have read:

The Honorary Local Secretaries of the British Association for the Advancement of Science to be held in Winnipeg from August 25 to September 1 of this year, are C. N. Bell, Esq., W. Sanford Evans, Esq. (Mayor), Professor M. A. Parker, and Professor Swale Vincent. Enquiries and communications on matters connected with the meeting should be addressed: To the Local Secretaries, British Association for the Advancement of Science, University of Manitoba, Winnipeg, Man.

A cablegram has been received at the Harvard College Observatory from Kiel, stating that the eighth satellite of Jupiter was photographed at the Greenwich observatory on January $16^{d}.551$, G. M. T. in

R. A.	$10^{h}\ 56^{m}\ 46^{s}.7$
Dec.	$+\ 7^{\circ}\ 40'\ 46''$
Daily motion in R. A.	$-\ 1^{m}\ 0^{s}$
Daily motion in Dec.	$+\ 1'$

The satellite is visible in a large telescope.

The American Geographical Society has made a collection representing the finest grades of wall maps, atlases and other appliances used in teaching geography in European schools. The collection has been made in the expectation that it will be useful to teachers of the subject and to those who are preparing to teach it. A descriptive catalogue has been prepared and the collection will be exhibited at the house of this Society, 15 West 81st Street, New York, till February 27. Later it will be loaned in whole or in part, to normal and training schools and other educational centers throughout the country as long as there is a demand for it.

The board of consulting chemists appointed by President Roosevelt to pass on pure food questions has announced a decision in regard to the use of benzoate of soda. The report is signed by President Ira Remsen, of Johns Hopkins University, chairman; Russell H. Chittenden, director of the Sheffield Scientific School of Yale University; John H. Long, professor of chemistry, Medical School, Northwestern University, and C. H. Herter, professor of physiological chemistry, College of Physicians and Surgeons, New York. Dr. Alonzo E. Taylor, professor of pathology of the University of California, is a member of the board, but he was absent in Europe during the experiments. The most important of the findings are:

First—Sodium benzoate in small doses (under 0.5 gram per day), mixed with the food, is without deleterious or poisonous action, and is not injurious to health.

Second—Sodium benzoate in large doses (up to 4 grams per day), mixed with the food, has not been found to exert any deleterious effect on the general health nor to act as a poison in the general acceptation of the term. In some directions there were slight modifications in certain physiological processes, the exact significance of which modifications is not known.

Third—The admixture of sodium benzoate with food in small or large doses has not been found injuriously to affect or impair the quality or nutritive value of such food.

The application made to Congress by Senator Lodge for charters for the National Institute of Arts and Letters and for the Academy of Arts and Letters having led to inquiries regarding the organizations, a statement has been issued by the executive committee of the academy. This institution, according to the statement, was organised in 1904 by the National Institute of Arts and Letters, which, in turn, had been organized by the American Social Science Association in 1898, with a view to the advancement of art, music and literature. The membership of the institute is 250, including representatives from all sections of the country, while the membership of the academy is limited to fifty and is chosen from that of the institute. The first seven members, chosen by ballot, were William Dean Howells, Samuel L. Clemens, Edmund Clarence Stedman and John Hay, representing literature; Augustus Saint-Gaudens and John La Farge, representing art, and Edward MacDowell, representing music. The academy has recently effected a permanent organization and has elected this executive committee: *President*, William Dean Howells; *Chancellor*, William M. Sloane, and *Permanent Secretary*, R. U. Johnson. The officers of the institute are: *President*, William M.

Sloane; *Vice-presidents*, Henry Van Dyke, John W. Alexander, Arthur Whiting, Brander Matthews, and Hamlin Garland; *Treasurer*, Hamilton W. Mabie, and *Secretary*, R. W. Johnson.

DR. WALTER B. PILLSBURY, director of the psychological laboratory, University of Michigan, and non-resident lecturer in psychology, Columbia University, will give a course of eight lectures on "The Psychology of Reasoning," in Schermerhorn Hall, Columbia University, at 4:10 P.M., on the days and on the subjects which follow:

Tuesday, January 19—"Logic and Psychology."

Wednesday, January 20—"Belief."

Friday, January 22—"Meaning and the Concept."

Tuesday, January 26—"The Psychology of Judgment."

Wednesday, January 27—"Judgment and Language."

Friday, January 29—"Inference, the Syllogism."

Tuesday, February 2—"Universal and Particular Conclusions."

Wednesday, February 3—"Induction and Deduction, Analogy."

UNIVERSITY AND EDUCATIONAL NEWS

MR. JOHN D. ROCKEFELLER has made a further gift of a million dollars to the University of Chicago. His gifts to the university now amount to more than $25,000,000.

AT the last meeting of the Board of Directors of Bryn Mawr College a gift of $100,000 was presented to the Board by the Alumnæ Association of the College, the first instalment of the sum of $1,000,000 which the alumnæ have undertaken to try to raise for the additional endowment of the college. The alumnæ have made it a condition of their gift that the money shall be used for academic salaries and they have endowed the chair of mathematics with this first $100,000 and stipulated that the money released by freeing the college from maintaining this professorship shall be used in raising the salary of each full professor in the college. Professor Charlotte Angas Scott has held since the opening of the college the chair of mathematics, which the alumnæ have endowed.

THE legislative board of visitors of the University of Missouri in its report to the governor of the needs of the university, recommended that the legislature appropriate $475,000 for new buildings. Of this amount, the board recommended that $250,000 be spent for a fireproof library building, $100,000 for a physics building, $75,000 for a chemistry building and $50,000 for a women's gymnasium.

AT Central University, Danville, Kentucky, Young Memorial Hall was dedicated on Friday, January 8. The speakers for the occasion were Dr. Henry S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching, Dr. Willis G. Craig, of Chicago, and Dr. J. M. Blayney, who spoke on behalf of the trustees of the university. Young Hall is a well constructed building, one hundred and twenty-two by seventy-six feet, made of buff brick and trimmed in light sandstone. The first floor and a portion of the basement will be occupied by the department of physics under the direction of Professor Clarence McChayne Gordon, Ph.D. (Göttingen); the second floor will be devoted to the work in chemistry, with Friend E. Clark, Ph.D. (Johns Hopkins), in charge.

A FOURTH report upon The High School Course in Botany adopted by the College Entrance Examination Board as a basis for its examinations, giving the course in full with certain explanatory matter, has recently been printed by a committee of the Botanical Society of America. A copy thereof will be sent to any one especially interested in this matter upon application to the chairman of the committee, Professor W. F. Ganong, Smith College, Northampton, Mass.

THE newspapers state that President Benjamin Ide Wheeler, of the University of California, has declined the presidency of the University of Michigan.

DR. E. A. NOBLE will be installed as president of the Woman's College of Baltimore on February 2.

PROFESSOR GEORGE F. SWAIN, professor of civil engineering at the Massachusetts Insti-

tute of Technology, and Professor H. E. Clifford, professor of electrical engineering at the institute, have been elected professors at Harvard University, in the School of Applied Science established under the McKay bequest.

DR. ARTHUR WILLIAM MEYER, professor of anatomy in the Northwestern University, has been called to the chair of human anatomy in Stanford University.

HAROLD D. NEWTON, assistant in chemistry at Yale University, has been elected professor of chemistry at the State College at Storrs, Conn.

DISCUSSION AND CORRESPONDENCE

CONVOCATION WEEK

To THE EDITOR OF SCIENCE: The leading editorial in your issue of January 8 contains much food for reflection. Those of us who were at the Baltimore meetings were offered a very unusual menu from which to choose according to our individual tastes and needs. Though one may sometimes have had to deviate from a normal ration, there is no reason why any one should have left the great meeting just closed with his hunger and thirst after knowledge unsatisfied.

Perhaps never before have there been so forcefully illustrated the advantages and disadvantages of a great program with multiple divisions and subdivisions, geographic segregation of the less loosely allied interests, and more or less effective contiguity of those more closely connected.

The purpose of this letter is to call attention to the loss experienced by a large part of the persons present of some of the choicest special "courses of the day." You enumerate interesting public lectures on several questions of broad scientific interest. Charged with the duty of attending executive sessions and the meetings of special sections and affiliating societies, I question whether a tithe of those participating in the great gathering knew of most of these opportunities until they had missed them. This resulted through no fault of officers, but through the common habit of men of looking first to the things that most immediately concern them—and, finding so much of immediate concern, failing to look further.

Why can not the American Association provide best for such lectures by suspending all section sessions before eleven o'clock, and holding a general session of forty-five minutes' duration every morning at ten for the presentation of a masterly address? The possibilities of interesting people who are not specialists in the work of the association seems to me likely to be furthered more by such a daily broad-subject large-man address, protected from encroachment of the special sections, than by any other one step which is feasible. Evening engagements are always likely to interfere with such lectures, and the evenings are becoming more and more the property of the affiliating national societies.

Complaint is made of the multiplicity of subjects and papers offered the various sections and societies. There is little profit in quarreling with the increasing scientific activity of the country. It has come and we all want it to stay. In my own field, the secretaries in Section G and the Botanical Society of America cooperated so well that the joint program was found workable to an unusual degree; and the special Darwin and ecology sessions of the national society, devoted to papers prepared on invitation, contrasted with the more democratic sessions of the section in a way very suggestive of a good outcome from a general differentiation of society and section activities along these cleavage lines.

WM. TRELEASE

GRAY'S NEW MANUAL OF BOTANY[1]

The writer of this note is not aware whether the authors have printed an unillustrated edition of their revised edition or not. Indeed, for the purpose of this criticism this would make little difference, that is, if the present illustrated copy is to be available for purchase by students. The writer may have a misconception of the value of Gray's "Manual," but takes this opportunity to allow that misconception to be made known, if it is to be classed as a misconception. He has

[1] By Robinson and Fernald, seventh edition, illustrated.

thought the great value of Gray's "Manual of Botany" as a guide for young students of the science has been that in the fewest words possible, and in the most exact manner those old manuals from year to year have always served as a guide for the young student to find the position of the plant in which he is interested in the plant kingdom. But in order to do this he has always had to work, except in the particular cases in which the common names were given. I note with a feeling of real regret and a feeling of real apprehension for the value of the "Manual" in training young students, that the authors have added pictures of many of the common species of plants. The best training in science that I have was given me through my personal efforts to identify plants in which I was interested. I feel, if at that time I had had Gray's "New Manual," seventh edition, illustrated, that much of any ability that I may now have along the line of noting fine distinctions in the structure of plants and details of variation, would never have been developed. There never was a time when I was not hunting for a shorter road, and had I had this well-illustrated "Manual" to look at I certainly should not have struggled up through the details of structure and wording. I could not have done so had I wished, for there would have been the pictures staring at me warning of a seeming waste of time. I could not have made errors which in the very making impressed the inefficiency of my work upon me. Though the drawings which the authors have given do not show the features and variations which the natural plant should bring to the student, yet they nevertheless show the general characters so plainly that when the pages open the student will have the name of his species lying immediately before him. My belief is that the value of the old "Manual," unillustrated, consisted essentially in the fact that it compelled the student to study out every detail of the plant before him in order to prevent the possibility of going astray in the divergent lines. Some one may say, now the work will be upon species and not upon genera and families. This must certainly be the result, for there will be no possible way for a teacher to prevent the student from tracing his plant backward. In this it would appear that the author believed that the actual fact of knowing the name of the plant will be of more value to the student than the digging out of the detailed characters observed in the specimens, and comparing these with the fine gradations in the meaning of the words of the descriptions. What teacher of botany has not had difficulty in getting the average student to study the characters of the dandelion for the reason that the common name has always been appended? To illuslustrate my point, I think I am safe in saying that many fairly well-trained botanists would have difficulty in determining the position of the plant known as ball-mustard (*Neslia paniculata*) if they should chance to have parts of the fruiting stalks only for examination. Yet the high-school teacher will only need, now with the "New Manual," to turn the question over to the most simple-minded of his pupils and he will settle it within the space of a few minutes by the simple process of comparing the picture with the plant. I ask, will the pupil have any more knowledge of plants when through?

Teachers of botany in agricultural colleges have long contended that much of the old-line botany is a waste of time, but I believe the readers of this note will have hard work to find a botanist of any intelligence who will agree that the pictures add to Gray's "Manual" as a student's text or reference book, or will in any way tend towards the improvement in the thinking ability of high-school students.

It is much to be hoped that high school superintendents and high-school teachers will not have the desire to have their pupils learn how to work by an easy road of picture comparison, and will still continue to use unillustrated manuals that their pupils may not be deprived of one of the finest sources of botanical education. Plant anatomy and plant physiology may have been greatly aided by the development of well illustrated texts, and the studies may have been popularized somewhat thereby, but the writer can not be-

lieve but that the illustrations of species published in connection with the "Manual" will do away with most of the usefulness it may have had as a training subject preliminary to advanced studies upon plant life.

Henry L. Bolley

North Dakota Agricultural College,
December 26, 1908

DISTRIBUTION OF THE NOBEL PRIZE

To the Editor of Science: In his interesting and important address as retiring president of the American Association for the Advancement of Science, printed in your issue of January 1, Professor Nichols makes two statements regarding which I wish to submit a bit of confirmatory evidence, derived from the awards of the Nobel prizes for the eight years that they have been established.

The two statements are: (1) "The men who have laid the foundations upon which civilization is built have nearly all been teachers and professors." (2) "We have less than our share of men of science."

Each year five Nobel prizes of a value of about $40,000 each are awarded, three of which alone, those in physics, in chemistry, and in physiology and medicine, concern us at present. These are awarded to the persons who have been most serviceable to mankind during the preceding year by making the most important discovery, invention or improvement in the designated field. The other two prizes are for work in literature and for work in the interest of international peace. Of the 24 prizes for scientific work of this description 16½ have been awarded to university professors, 3 more to directors of scientific research institutes, 3 more to teachers in scientific schools of high grade, viz., Royal Institution of London, École Polytechnique, and School of Physics and Industrial Chemistry of Paris (a divided prize) and the Academy of Military Medicine in St. Petersburg, and only 1½ to persons apparently not engaged in teaching. Even if allowance is made for one or two cases, like that of Major Ronald Ross, in which the scientific work was done first and the position as a teacher resulted from it, it seems clear that at least four fifths of these prizes have been awarded to teachers in institutions designed to encourage research.

With reference to the second point quoted above it should be noticed that the Swedish committees of award have shown no tendency to favor Swedish or Scandinavian scientists. They have allotted the prizes to persons in the various countries as follows:

Germany	8	Sweden	1
England	5½	United States	1
France	4½	Italy	½
Denmark	1	Spain	½
Netherlands	1	Total	24
Russia	1		

Does not the above grouping correspond roughly to the order in which most scientists would arrange the great countries with reference to their important contributions to the advance of knowledge and support in an interesting way the second claim of Professor Nichols?

Walter F. Willcox

Cornell University,
January 11, 1909

QUOTATIONS

HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

It seems probable that the taking from the institute by Harvard of two of its leading professors will bring up again the question of a consolidation or of an alliance between these two educational institutions. Recognizing the position occupied by the institute, President Eliot, of Harvard, throughout the whole of his long administration has refrained from developing technical education along extensive lines. His attitude in this respect is the more noticeable when the great development of the university in all other professional fields is considered, and it is also remarkable because during this period there has been great development in technical education in almost all other institutions, the students in technical subjects forming in many institutions by far the larger part of the undergraduate department.

Only to such subjects was special attention given as was demanded by specific gifts, mining, metallurgy and architecture being instances. The reason for this restraint was regard for the institute and the admirable work which it was doing and the belief that there should be but one technical school in Boston. President Eliot continually sought a merger with the institute and refrained from developing a competing school.

The McKay bequest to Harvard brought about a crisis and two years ago more active steps were taken to consolidate the institute with Harvard. It is related that once when the merger came up before the Harvard Faculty of Arts and Sciences a member of the faculty inquired what Harvard was to get out of it, to which President Eliot replied: "The merger is a subject under discussion by two groups of gentlemen, the Corporation of the Massachusetts Institute of Technology and the Corporation of Harvard University, and the sole consideration is the good of technical education in the community and in the country at large."

When the merger was abandoned Harvard still sought an organization which would compete in the least possible manner with the institute. The terms of the McKay bequest, however, made it necessary that Harvard give instruction in the same subjects as is given at the institute, and the university found its best solution of the situation in the organization of the Graduate School of Applied Science. Following its general motive of giving the best education to the exceptional student, Harvard has developed those subjects which are not touched upon by the institute, such as forestry and applied biology, the latter in the reorganized Bussey Institution, which has been made a part of the Graduate School of Applied Science. The McKay bequest now makes it necessary to develop the other branches, and in so doing to seek the best possible men. Two such men are considered Professor Swain and Professor Clifford.

The election of Professor A. Lawrence Lowell as president of Harvard, it is also thought, may have an influence in bringing Harvard and the institute into closer relationship. President-elect Lowell is a member of the corporation of the institute and when the merger discussion was on he used his utmost efforts to bring about a union. As president of Harvard he will be in a better position to accomplish this object. Harvard will have ample funds for its School of Applied Science and can employ the best teachers there are. It also has sufficient land for the location of proper buildings. The institute, on the other hand, is handicapped by an improper location and insufficient funds to compete successfully against Harvard, fortified by the McKay bequest.—Boston *Transcript*.

SCIENTIFIC BOOKS

Mechanics of Engineering, comprising Statics and Kinetics of Solids; the Mechanics of the Materials of Construction, or Strength and Elasticity of Beams, Columns, Shafts, Arches, etc., and the Principles of Hydraulics and Pneumatics, with Applications. For use in Technical Schools. By IRVING P. CHURCH, Professor of Applied Mechanics and Hydraulics, College of Engineering, Cornell University. Revised edition. Pp. 854. New York, John Wiley & Sons. 1908.

Since the publication of Rankine and Weisbach, perhaps no single treatise which has attempted to cover the wide field of applied mechanics as taught in our American colleges of engineering, has been more useful than this one.

It has appeared in edition after edition until it would seem as if practically all the younger generation of engineers in this country must be familiar with it either as a text-book or as a work of reference. The book originally appeared in parts during the years 1886-7-8, so that it has now quite attained its majority. Its wide use by the profession has been due to its merits, which are many.

I may here mention some of them: 1. The subject matter of this book, which is central and essential to the training of every engineer, is presented as a series of semi-detached problems or developments which may be readily mastered separately, no one of which

requires ready familiarity with other parts of the book to make it available.

This kind of treatment may be likened to that used in the Euclidian geometry where a separate demonstration is invented for each proposition and few general methods are employed, a treatment in contrast with the developments of analytical geometry where general laws and methods are applied to successive cases or investigations. This kind of treatment has many advantages from the point of view of the practical man, while its disadvantages are perhaps principally encountered by those who must at some period of their career go somewhat more deeply into theoretical questions.

The contrast between the kinds of treatment I have in mind will be clear to any one who compares Grashof with Church.

2. The diagrams employed by Church were, I think, unique at the time his book was first published, in their combined simplicity and perspicacity. This arose, as I imagine, from the way in which the book came into existence as a transcript of the author's blackboard lectures before his classes. Professor Church had the opportunity while yet a young man to devote himself to the single subject of applied mechanics exempt from the distractions which usually beset college teachers of that period of life who commonly have to teach first one and then another subject. He improved that opportunity to prepare this text-book. It was an excellent thing to do, and it was well done. It has stood the test of prolonged use. No important or extensive revision of the work has been undertaken by the author until now, and even now its general character and text has remained unchanged. To make a rough estimate, possibly 100 pages scattered throughout the book have been rewritten and replaced by a new or revised text, leaving the paging unchanged of so much of the original text as is retained. It is needless to say that the emendations and revisions have added greatly to the value of the book by the introduction of much new matter now necessary to the engineer, notably concrete beams, circular ribs and hoops, thick hollow cylinders and spheres. The most important matters thus added are in the more abstruse parts of the subject, so that for the ordinary student the most important addition consists in the introduction of many valuable illustrative examples, a change which will meet general commendation. Indeed, the book would be improved by the introduction of still further examples. Another change, apparently small, but of real importance, is the adoption of 1.41 for the ratio of the two specific heats of gases instead of 4/3 used in previous editions, following the example of Weisbach. While 4/3 may be admissible as a rough average for gases whose molecules consist of three or more atoms, the gases the engineer ordinarily deals with consist so largely of diatomic molecules, especially air, that there is no excuse for using a value differing from the experimental value for air, unless the gas to be treated be known to be some polyatomic fluid, such as superheated steam, carbonic acid, ammonia or the like.

As a whole the book is singular for its clear, lucid treatment, wise selection of subjects and subordination of mathematical to mechanical considerations. It has more definitely in view the needs of the civil engineer than the mechanical or the electrical engineer. Indeed, the devotee of any of these branches of engineering must expect ultimately to specialize to a far greater extent than is possible in a general treatise like this.

HENRY T. EDDY

Allen's Commercial Organic Analysis. Third edition. Vol. II., Part III.

The volume in hand, which completes the treatise, is chiefly devoted to the aromatic substances and to the essential oils, resins, etc. The first part treats of the benzol derivatives included under the following heads: Characters and Classification of Aromatic Acids, Benzoic Acid and Its Derivatives, Cinnamic Acid and Its Derivatives, Salicylic Acid and Its Allies, Dihydroxybenzoic Acids and Their Allies, Gallic Acid and Its Allies, Phthalic Acids. Special attention is paid to salicylic acid, the detection and determination of which

is so important in relation to the pure food law. The various flavoring substances, such as vanillin, saccharin, etc., are treated at length, as are the medicinally important bodies throughout the book. The main portions of the volume, devoted to the essential oils, are, in the opinion of the reviewer, well written and up-to-date. The Extraction of Essential Oils, Classification, General Characters, Analysis, Constituents, Hydrocarbons, Olefinic Terpene Alcohols and Aldehydes, Cyclic Terpene Alcohols, Phenols and Phenolic Ethers, Ketones, Sulphuretted Constituents, Special Characters of Individual Essential Oils and Terpeneless Essential Oils are each discussed in a separate paragraph. The material given is quite full enough for practical purposes and no serious errors were detected. Especially useful are the tables of the important essential oils and of their constituents. Rubber and the resins are thoroughly discussed as follows: Caouchouc and Gutta-percha, Chemical Composition of Resins, General Character of Resins, Resins, Oleo-Resins or Turpentines, Gum-Resins. In general the volume is quite satisfactory.

ALFRED HOFFMAN

Las Plantas Usuales de Costa Rica. By HENRI PITTIER. Washington, H. L. & J. B. McQueen. 1908.

This work on the useful plants of Costa Rica will be welcomed by students of economic botany and tropical agriculture. Professor Pittier has already produced several works relating to tropical agriculture, contributions to the flora of Costa Rica, monographs of certain Central American genera of plants, and treatises on the ethnology and languages of several aboriginal tribes of Central and South America. The present work is illustrated with thirty-one plates, most of which are reproductions of natural size photographs of fruits and plants made by the author. An account of physical features and climate of Costa Rica is given, together with the characteristic plants of the various zones of vegetation, a list of plants grouped according to their uses, the etymology of their common names, derived as they are from various sources, Nahuatl, or Aztec; the language of the ancient inhabitants of Hayti; various tribes of Central America; and even from the Quichua of the Andes of South America. In addition to these names those of Spanish origin are given. Then follows an alphabetical enumeration of the useful plants of the republic, a tabulated list of the number of species belonging to each plant family thus far known to occur within its limits, and an index to the plants under their botanical names. The work ends with a very complete bibliography of works on tropical agriculture and the botany of Central America. Professor Pittier's present work is the first of its kind dealing with Central America. It was published under the auspices and by the direction of the government of Costa Rica.

W. E. SAFFORD

Human Foods and their Nutritive Value. By HARRY SNYDER. New York, The Macmillan Co. 1908.

At last man is having his share of the results of science applied to animal life. The author clearly states the twentieth century view when he says:

> It is believed that a better understanding of the subject of nutrition will suggest ways in which foods may be selected and utilized more intelligently, resulting not only in a pecuniary saving, but also in greater efficiency of physical and mental effort.

This volume will not only supply a need, but will satisfy a real want, a want becoming acutely felt by the laity who are asking for some comprehensible statements as to human foods and their various qualities and relative values. One feels instinctively the master dealing out knowledge at first hand. Here is no compiler sifting more or less ancient and possibly outgrown material.

Not only teachers and students but the business man who has been warned by his physician to take thought for his diet, the club woman who has to "write up a paper" will find sound science as well as useful information about the many kinds of human foods. Such passages as the two quoted below convey economic lessons of great importance.

In older agricultural regions, where the cost of beef production reaches the maximum, dairying is generally resorted to, as it yields larger financial returns, and as a result more cheese and less beef are used in the dietary. As the cost of meats is enhanced, dairy products, as cheese, naturally take their place (page 96).

Food notions have, in many instances, been the cause of banishing from the dietary wholesome and nutritious foods, of greatly increasing the cost of living, as well as of promulgating incorrect ideas in regard to foods, so that individuals and in some cases entire families have suffered from improper or insufficient food (page 253).

The tables showing composition, digestibility, etc., are taken from the publications of the U. S. Department of Agriculture, based on American work in which Professor Snyder has played a large part. The chapters on cereals and bread are mainly the results of studies in his own laboratory.

It would have added to the value of the volume as a text-book if some of the illustrations had been better prepared. A student would find some difficulty in recognizing the varieties of starch from the indistinct figures given. On page 90 the centrifuge should have been designated as of fractional size as compared with the other apparatus or have been omitted altogether.

The water analyst wishes there had been a word of caution on page 278 as to the metals of which cheap water stills are often made. The discussion of the ice supply might also have included the statement that all ice used directly in foods and drinks should be crystal clear and not frothy or bubbly.

The chapter on laboratory practise and the admirable review questions will prove most helpful not only to teachers of home economics but also to the general science teachers many of whom are just ready to use this kind of information in their classes.

Ellen H. Richards

SCIENTIFIC JOURNALS AND ARTICLES

The opening (January) number of volume 10 of the *Transactions of the American Mathematical Society* contains the following papers:

Eduard Study: "Zur Differentialgeometrie der analytischen Curven."

G. A. Miller: "The central of a group."

J. I. Hutchinson: "The hypergeometric functions of N variables."

Virgil Snyder: "Surfaces derived from the cubic variety having nine double points in four dimensional space."

A. E. Young: "On a certain class of isothermic surfaces."

A. E. Landry: "A geometrical application of binary syzygies."

L. E. Dickson: "Definite forms in a finite field."

The December number (volume 15, number 3) of the *Bulletin of the American Mathematical Society* contains: "The September Meeting of the San Francisco Section," by W. A. Manning; "Note on Statistical Mechanics," by E. B. Wilson; "On certain Constants Analogous to Fourier's Constants," by C. N. Moore; "The Cologne Meeting of the Deutsche Mathematiker-Vereinigung," by R. G. D. Richardson; "Goursat's Cours d'Analyse," by W. F. Osgood; "Shorter Notices": D'Ocagne's Calcul graphique et Nomographie and Le Calcul simplifié, by L. I. Hewes; Durège's Theorie der elliptischen Funktionen, by J. I. Hutchinson; Veblen and Lennes's Introduction to Infinitesimal Analysis, and Hedrick's Algebra for Secondary Schools, by James Pierpont; Sturm's Lehre von den geometrischen Verwandtschaften, Erster Band, and Scheibner's Beiträge zur Theorie der linearen Transformationen, by Virgil Snyder; Lebon's Table de Caractéristiques des Facteurs premiers, by G. A. Bliss; Serret-Scheffers's Lehrbuch der Differential- und Integralrechnung, by A. R. Crathorne; Blaschke's Mathematische Statistik, by H. L. Rietz; Fleming-Aschkinass's Elektrische Wellen-Telegraphie, by E. B. Wilson. "Notes"; "New Publications."

The January number of the *Bulletin* contains: "The October Meeting of the American Mathematical Society," by F. N. Cole; "On the Groups Generated by two Operators Satisfying the Condition $s_1s_2 = s_2^{-2}s_1^{-2}$," by G. A. Miller; "The Teaching of Mechanics" (review of Jeans's Theoretical Mechanics), by E. W. Brown; "Economics" (review of

Fisher's Nature of Capital and Income and Rate of Interest), by E. B. Wilson; "Shorter Notices": Hesse-Gundelfinger's Analytische Geometrie der geraden Linie, des Punktes und des Kreises in der Ebene, by E. J. Wilczynski; Gray's Bibliography of the Works of Sir Isaac Newton and White's Scrapbook of Elementary Mathematics, by D. E. Smith; Royal Society Catalogue of Pure Mathematics, by G. A. Miller; Carslaw's Fourier's Series and Integrals, by J. E. Wright; Grimsehl's Angewandte Potentialtheorie in elementarer Behandlung, by E. B. Wilson. "Notes"; "New Publications."

BOTANICAL NOTES

TWO RECENT PAPERS ON ALGAE

R. E. BUCHANAN's paper—"Notes on the Algae of Iowa"—in the *Proceedings of the Iowa Academy of Science*, Vol. XIV., opens with a historical account of the study of the Iowa algae, in which eight previous papers are noted extending over a period of twenty-eight years from 1880 to the present. The 181 species credited to the state are arranged mainly according to the system given in West's "British Freshwater Algae," and for each particular localities are given with the name of the collector, and often the date of the collection.

Of the *Myxophyceae* there are 45 species enumerated, of *Bacillaricae* 5; *Heterokontae* 4; *Chlorophyceae* 127. No *Phaeophyceae*, nor *Rhodophyceae*, are known to occur in the state. This paper is to be considered as a preliminary report, for when the whole of the material collected by the author is worked over it is confidently predicted that many more species will be added to the algal flora of the state.

Somewhat like the foregoing is Conn and Webster's "Preliminary Report on the Algae of the Fresh Waters of Connecticut," published as Bulletin 10 of the State Geological and Natural History Survey. The authors say of it that "it is thought that it will be found to contain most of the common algae of the state." It, also, is based upon West's system, but no attempt is made to distinguish anything lower than the genera, the species merely being enumerated, usually without localities being given. A somewhat hasty count of species gives for Myxophyceae 55 species; Heterokontae, 3; Chlorophyceae, 223; and Rhodophyceae, 10. Comparing these with the Iowa algae we find that the species of *Oscillatoria* are the same in number (9) in the two lists, that Iowa has 12 species of *Oedogonium*, to 2 in Connecticut: so of *Cladophora* the corresponding numbers are 7 for Iowa and 2 for Connecticut; *Vaucheria*, 7 and 3; *Zygnema*, 4 and 5; *Spirogyra*, 25 and 20. In these genera the preponderance is greatly in favor of Iowa, but when we take up the desmids (*Desmidiaceae*) it is quite the opposite, standing 26 for Iowa, to 109 for Connecticut. Forty-four well-drawn plates add greatly to the usefulness of the Connecticut report.

PAPERS ON FUNGI

THE quite extended paper (86 pages, and 9 plates) by George R. Lyman on "Culture Studies on Polymorphism of Hymenomycetes" (*Proc. Boston Society of Natural History*, vol. 23, No. 4, pp. 124–209) records the results of careful cultural studies, especially of woody and encrusting species. Besides the normal basidiospores formed by these fungi there are four others which may be regarded as secondary, viz., (*a*) chlamydospores; (*b*) oidia; (*c*) budding cells; (*d*) conidia. The author concludes that "a considerable majority of Hymenomycetes possess no secondary spores; that oidia are common among the *Agaricaceae* and *Polyporaceae*, and are confined to these two families; that chlamydospores occasionally occur in connection with the basidio-fructification, as in *Nyctalis*, *Ptychogaster*, and *Fistulina*, and are quite widely distributed on the mycelia of all families; and that conidia and other highly specialized secondary methods of reproduction are rare, and occur more frequently in the *Thelephoraceae* than in the higher families."

Professor Olive's paper on "Sexual Cell Fusions and Vegetative Nuclear Divisions in the Rusts" (*Ann. Bot.*, Vol. XXII., pp. 331–360) explains to a certain extent some of the discordant results of Blackman's and Christ-

man's earlier investigations. He concludes that the conjugations by means of which the cells of the rusts change from a uninucleated to a binucleated condition are not to be regarded as simple fusions for nutritive purposes as is common in many fungi, but as marking the beginning of the sporophyte generation.

In a paper entitled "Infection Experiments with *Erysiphe cichoracearum*" (*Bull. Univ. Wis.*, Science Series, vol. 3, pp. 337–416) Dr. G. M. Reed takes up the question of "physiological species," and after making a great many infections concludes that his work "throws considerable doubt upon the existence of distinct biological forms" in mildews as well as in certain species of rust. The paper is so largely made up of tables that it can not be summarized.

C. H. Kauffman's "Unreported Michigan Fungi for 1907, with an Outline of the Gasteromycetes of the State" (in Tenth Ann. Report Mich. Academy of Science, pp. 63–84) adds many hitherto unreported species to the Michigan flora and includes a useful arrangement of the Gasteromycetes. The same author's paper on the Physiology of the Saprolegniaceae (in *Ann. Bot.*, Vol. XXII., pp. 361–387) adds to our knowledge of the structure and development of these interesting fungi, and is especially valuable as suggesting methods of culture. The author modestly says that his paper "adds something more of evidence towards the doctrine that sex in plants is determinable by external conditions," distinctly disclaiming however that it is yet conclusive.

CONNECTICUT MOSSWORTS

UNDER the title "The Bryophytes of Connecticut" Professor Doctor Evans and Mr. G. E. Nichols publish (in *State Geol. and Nat. Survey, Bull.*, No. 11) an important contribution to our knowledge of the mosses and liverworts of that state. It opens with a well-written introductory chapter of 16 pages on the general structure of these plants, followed by a 5-page history of bryology in Connecticut (from which we learn that the first systematic work on these plants was undertaken by D. C. Eaton about half a century ago), half a dozen pages of ecology, and two, on the economic values of bryophytes. Then follows the Catalogue of 387 species, distributed as follows: *Marchantiales*, 12; *Jungermanniales*, 92; *Anthocerotales*, 3; *Sphagnales*, 31; *Andreaeales*, 2; *Bryales*, 247. Under each species are given habitat, localities in the state, general distribution, exsiccati and references to descriptive or other papers. The bibliography includes 81 papers, beginning with Sullivant's "Anophytes" in the second edition of Gray's "Manual," in 1856, and coming down to the present. An excellent index closes this useful work.

CHARLES E. BESSEY

UNIVERSITY OF NEBRASKA

ANTHROPOLOGY AT THE BRITISH ASSOCIATION

THE Anthropological Section (H) of the British Association, held at Belfast last September, was notable for the number and excellence of the papers, many of which were fully illustrated with lantern slides. A prècis of the proceedings will be found in *Nature*, but readers of SCIENCE may like to hear how America was represented. In his presidential address on "Totemism" Mr. A. C. Haddon criticized the terminology employed by most American students. He held a confusion had been made between totemism proper and the cult of a guardian spirit; doubtless American anthropologists will have something to say on this subject. Mr. W. J. Knowles, a local archeologist, described some stone axe factories that he had discovered near Cushendall in Co. Antrim, which recall in a small way, as was pointed out at the time, the bowlder quarries described by Dr. W. H. Holmes in the Fifteenth Annual Report of the Bureau of Ethnology. Mr. Knowles also exhibited some leaf-shaped flint objects which were probably an intermediate stage in the manufacture of arrow- and spear-heads and he alluded to the analogous leaf-shaped blades found by Mr. Holmes in the Piny branch quarry sites. Dr. W. H. Furness, third, of Philadelphia, read a very interesting and important paper on the "Ethnography of the Nagas of Eastern Assam," which was illustrated by a fine series

of colored photographs that often elicited applause from the audience. This paper will be printed in full in the *Journal of the Anthropological Institute*. Dr. Furness has traveled a great deal in the far east and his comparisons of the Nagas with the interior tribes of Borneo will prove of value—as he knows them all so well, as is proved by his recently published magnificent volume on "The Home-life of Borneo Head-hunters" (Lippincott Co.) and by the very valuable collection he has given to the Free Science and Art Museum of Philadelphia. Dr. Furness does not find a very close resemblance between the Nagas and Borneans which some have expected should occur. The Report of the Students Ethnological Survey of Canada Committee is practically nothing more than a memoir by Mr. C. Hill-Tout on the Mainland Halkomē'lᴇm, a division of the Salish of British Columbia, but more especially with the Tcil'qē'uk and Kwa'ntlᴇn tribes of the Lower Fraser River. These ethnological studies run to over ninety pages, the greater number of which are devoted to linguistics. The Royal Society of Canada has at least awakened to the importance of recording the rapidly vanishing lore of the Canadian aborigines and it is to be hoped that some action will now result and that the Canadian government will assist in this important national work. The reading by Mr. J. L. Myres of a suggestive paper written by Dr. W. H. Holmes, entitled "The Classification and Arrangement of the Exhibits in an Anthropological Museum" led to a very interesting discussion in which Dr. W. E. Hoyle, Professor Boyd Dawkins, both of the Manchester Museum, Mr. H. Balfour, of the Pitt Rivers Museum, Oxford; Mr. G. Coffey, of the Royal Irish Academy Museum, Dublin; Mr. E. Lovett, and Dr. A. C. Haddon took part. Several speakers referred to characteristic features of American museums and pointed out some of the ways in which the English museums could be rendered more instructive and popular. It is beginning to be realized that a museum should be the educational center of a town, but in order to be that it must itself first be educational in its scope.

H.

SPECIAL ARTICLES

THE PRESENCE OF WATER VAPOR IN THE ATMOSPHERE OF MARS DEMONSTRATED BY QUANTITATIVE MEASUREMENTS

IN 1867, Huggins first announced his detection of a slight intensification of the bands of aqueous absorption in the spectrum of Mars. The observation was an exceedingly delicate one, and resting, as it did, solely on eye-estimates of the relative intensities of weak lines which certainly do not differ very much in appearance, it is not remarkable that other observers, with even more powerful instruments, have declined to endorse the supposed intensification of aqueous bands, and have even denied its existence. Vogel, indeed, came to the aid of Huggins in 1873, and the opinion of two such accomplished observers was worth something. The question, however, up to the present time, has remained a matter of opinion only, with the honors about equally divided, the Lick observers declaring positively that no intensification was visible.

Under these circumstances, Professor Lowell's announcement that Mr. V. M. Slipher had succeeded in photographing the little *a* band in the spectrum of Mars under conditions which left no doubt of its relatively greater strength, may have passed with some as no more than a fresh subject for incredulity, and one to be relegated to the same limbo of "matter of opinion." I therefore resolved to try to place these observations on a more solid basis, and with material aid from Professor Lowell, who has generously placed at my disposal the means for testing my ideas, I am now able not only to confirm Mr. Slipher's discovery, but to give numerical values for the amount of intensification of the *a* band. Besides this, it now becomes possible to give an approximate estimate of the amount of water vapor which is present in the air of Mars.

The instrument with which the examination of the spectrograms is made, I call a spectral band-comparator. It can be used for comparing the intensities of either lines or bands in two different spectra, but was more especially intended for the examination of

faint or diffuse bands in spectra of small dispersion, whence the name. After trial of other comparison objects, I conclude that nothing succeeds as well for the purpose of matching one of these hazy bands in a photograph of the spectrum as an equivalent, but not identical line or band in another spectrum of identical intensity as to the general background of continuous spectrum. The comparison line is chosen both narrower and brighter than the one to be measured in order that, when placed a little out of focus by a displacement of the objective of the microscope with which it is viewed, it may appear both broader and fainter, and may thus resemble the object with which it is to be compared. Beyond this, the observation consists simply in repeated settings of the microscope in its out-of-focus position corresponding to apparent equality of the hazy bands, and in the determination of a curve of brightness by a careful photometric calibration of the scale of the instrument.

The measurement is safeguarded in every possible way, and especially by duplicate measures, made on each one of the plates, of a line which is certainly solar and not subject to modification by the atmospheres of the planets. For this purpose the hydrogen C line has been made a test object, and also a means by which the measures on little a may be corrected for trifling variations in the focus of the spectograph in the intervals between successive spectrum exposures.

The measures on great C in the spectra of Mars and the moon, taken at Flagstaff by Mr. Slipher at such times as to give equal altitudes for the two bodies at midexposure, and for such durations as to produce equivalent intensity of spectral background under identical photographic development, have a ratio which never departs much from unity; and the average ratio for all of the plates measured approaches unity much within the limit of the probable error. On the other hand, similar series of measures on little a show without exception that little a is more intense in the spectrum of Mars than in that of the moon, with equal C lines and for equal altitudes.

The average value of the direct readings of the spectral band-comparator makes the intensity of a in the spectrum of Mars $= 1.224 \pm 0.0245$. The observations in full may be found in *Lowell Observatory Bulletin*, No. 36.

This result requires further correction by means of a calibration curve for the readings of the spectral band-comparator, before it can be stated in absolute units. To obtain such a curve, I have measured the disappearances of the same spectral line at various settings of the instrument with the modification of Pritchard's wedge-photometer invented by Dr. Charles H. Williams, of Boston, and called by him a "simplex" photometer. It is a well-known fact that the eye is much more sensitive to slight variations of intensity than we might have anticipated. But just as we do not recognize our faculty of discrimination, neither do we recognize how great the actual differences of intensities of illumination may be which correspond to our fallacious impressions of the same. Differences of illumination which we note immediately, but which are not judged to be great, which in fact, at first guess, we estimate as but a few per cent., turn out to be many hundred per cent. when made the subject of exact measurement. It is probable that very few would guess in the absence of exact measurement that a first-magnitude star is one hundred times as bright as a sixth magnitude. Bearing these facts in mind, it need excite no surprise when I state that the actual ratio of intensity of the a band in Mars, when expressed in absolute units, is much greater than would at first be inferred from the direct readings. I find that the real intensity of the band in the spectrum of Mars in the month of January, when the dew-point at Flagstaff was about 20° F., was *four and a half times as great* as in the lunar spectrum at the same altitude.

I have endeavored to find out how far it is possible for this result to have been vitiated by inequalities of photographic development. Some of the spectrograms of Mars have been over-exposed, but by a detail in the mode of procedure to which only incidental allusion has been made, namely, by altering the illumination of one or the other of the spectrograms

until identical illumination has been obtained, this diversity of photographic action, due to variation of exposure, or of development (of course with the proviso that such variations are never excessive), is apparently taken care of. At any rate, I find no difference in the results which can be traced to this cause.

Admitting that the little *a* band is four and one half times as intense in the spectrum of Mars, if we may assume that the intensity of the band is proportional to the total amount of vapor present in the combined air columns traversed by the rays, as it is very nearly in the case of incipient absorption, it is perhaps permissible to say, since the rays pass twice through the atmosphere of Mars, that on the average Mars has $0.5 \times (4.5 - 1.0) = 1.75$ times as much aqueous vapor in its atmosphere as that which exists above Flagstaff in the month of January, or roughly, since one and three quarters times the amount of water vapor in the surface air of Flagstaff would be 2.17 grains per cubic foot, or 5.0 grams per cubic meter, it may be concluded that the dew-point on Mars would be 33° F., if the distribution of moisture were the same in the upper air of the two planets. In this respect, however, there is a very wide divergence of conditions on the two worlds, since, as I have shown in my paper on "The Greenhouse Theory and Planetary Temperatures," in the *Philosophical Magazine* for September, 1908 (p. 469), the proportion of aqueous vapor existing at great elevations above the surface on Mars is very much greater than here. This is due to the comparatively rare atmosphere of Mars, to the low boiling point of water on that planet where water evaporates much more readily than here, and to the prevailing desert conditions, that is to say, to the infrequency of those atmospheric conditions which conduce to the formation of cloud and rain. Through these causes, aqueous vapor on Mars diffuses to greater heights and remains suspended in the air for longer intervals than with us. As a consequence, although there may be a very extensive protecting mantle of highly absorbent vapor which prevents surface radiation and conserves surface temperature, the dew-point at the surface remains low, probably seldom rising much above the freezing point, and the prevalent conditions on Mars are those of a mild but desert climate, as Professor Lowell has all along maintained.

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THE SELACHIANS ADMITTED AS A DISTINCT CLASS

EVER since 1873 (*Am. Journ. Sci.* (3), 6, 434, 435) I have claimed class rank for the Selachians or Elasmobranchiates. This view has been later accepted by most American ichthyologists, and notably by Jordan, since 1902.[1] At last two European naturalists, of great eminence, have come to the same conclusion.

Professor A. A. W. Hubrecht, in the *Quarterly Journal of Microscopical Science* for November, 1908 (p. 156), has stated that "a division of the vertebrates in the superclasses of Cyclostomata, Chondrophora, and Osteophora might suggest itself, Amphioxus remaining yet more isolated in its superclass of Cephalochordata. The CHONDROPHORA would then contain the Elasmobranchs, the OSTEOPHORA all the other higher vertebrates."

Mr. C. Tate Regan, in the *Annals and Magazine of Natural History* for January, 1909 (8. ser., 3, 75), has recalled that he had "already expressed the opinion that the true Fishes are at least as distinct from the Selachians, on the one hand, and the Batrachians, on the other, as any of the vertebrate classes are from each other, and are equally entitled to rank as a class,"[2] and insists on their claim to class distinction.

Hubrecht and Regan, it is true, are not the first or only European naturalists to differentiate the Selachians as a class from the Pisces, for Geoffroy Saint-Hilaire and La-

[1] Up to 1887 Jordan had regarded the Selachians as a "class Elasmobranchii"; from 1888 to 1902 he associated them with the Pisces under two subclasses, Selachii and Holocephali; in 1902 he reverted to his former view. (See "Guide to the Study of Fishes," I., 1905, pp. 506, etc.

[2] Regan, *Proc. Zool. Soc.*, 1906, p. 724, and "Biol. Centr.-Am.," Pisces, p. viii (1908).

treille did so nearly a century ago (in 1825), but almost all later Europeans have looked with much disfavor on such a separation. It must not be forgotten, either, that L. Agassiz, over half a century ago (in 1857), also separated the Selachians as a distinct class but, it should be said, he also differentiated the "Ganoids" as an equally distinct class.[8] It is scarcely necessary to add that the reasons for the present differentiation of the Selachians are different from those influencing the early zoologists.

It may be hoped, in the interests of vertebrate morphology, that the view that has at last found favor among such active European naturalists as those noticed will be more prevalent than heretofore.

THEO. GILL

SEVENTH ANNUAL MEETING OF THE AMERICAN SOCIETY OF VERTEBRATE PALEONTOLOGISTS

THE seventh annual meeting was held in the geological laboratory of Johns Hopkins University, Baltimore, Md., December 28–30, 1908.

The meeting was called to order by President R. S. Lull on Monday, December 28, at 2:30 P.M. The minutes of the preceding meeting were read and approved. The treasurer's report was read and accepted. A letter from Professor W. B. Clarke was read, giving notice of courtesies extended to the society. A letter from the U. S. Fish Commission was read, acknowledging receipt of resolution regarding extinction of the great marine mammals, stating the sympathy of the commission with the views there expressed, and asking for suggestions in regard to prevention of this extermination.

The president appointed Messrs. Williston, Case and Matthew a committee to nominate officers for the ensuing year.

On motion it was resolved that the business meeting be postponed until 10:30 A.M. on Wednesday and that the meeting proceed to the reading of papers.

The reading of the presidential address by R. S. Lull, on "Dinosaur Societies," followed. The address discussed the relationships and the geological and geographical distribution of the several groups of *Dinosauria* and suggested hypotheses of phylogeny and migration to explain these facts of distribution. (The address will be published elsewhere.)

Discussion: Dr. Williston expressed his sense of the importance and interest of the paper. He did not agree with the author in making the early Mesozoic migrations via a North Atlantic land bridge; a more probable alternative was by way of southern land connections. In favor of this view he pointed out our lack of knowledge of southern Mesozoic land faunæ, the easier communication at that time between the southern continents, and especially the presence of certain common types, such as Dicynodonts, in the early Mesozoic land faunæ of North America and Africa, although they are not found in the intervening northern land masses. He agreed with Professor Lull as to the Triassic age of *Nanosaurus.* In support of the lower Cretaceous age of a part of the Morrison formation he cited the discovery of *Morosaurus*, a Morrison genus, in the lower Cretaceous Trinity sandstone of Oklahoma. He believed that the American upper Cretaceous genera *Palæoscincus* (Judith River), *Stegopelta* (Lower Benton) and *Ankylosaurus* (Hell Creek) were closely related, if not identical, and were all derivable from *Polacanthus* of the Wealden of Europe. The recent discovery of *Ceratopsia* and of *Hadrosaurus* in the European Cretaceous reduces still further the supposed isolation of our late Cretaceous land fauna from that of Europe.

The meeting then adjourned. The second session was called to order at 9:30 A.M. Tuesday.

A specimen from the Conemaugh beds of West Virginia was submitted for discussion by Dr. White. The specimen appears to be the tibia or radius of a large reptile. Its nature and relationships were discussed especially by Drs. Williston, Case and Dean. It was considered to be beyond doubt a bone or natural cast of a bone of a large Pareiasaurian, exceeding in size and considerably older geologically than any known member of the order. On motion it was resolved that the society expresses its sense of the importance of the specimen and of the desirability of having it fully described and illustrated.

Dr. Williston then exhibited articulated skeletons of *Pariotichus* and *Lysorophus*, obtained for the University of Chicago in western Texas last summer. The reptiles of the American Permian included four chief groups, the Pelycosaurs, the Cotylosaurs (including Chelydrosauria) the *Pari-*

[8] Agassiz, "Cont. to Nat. Hist. U. S.," I., 1857, p. 187. Agassiz recognized three orders of Selachians ("Chimeræ, Galeodes and Batides") and six (?) orders of Ganoids ("three orders, Cœlacanths, Acipenseroids and Sauroids; and doubtful, the Siluroids, Plectognaths and Lophobranches").

otichus group and one other. The *Pariotichus* group is ordinally but not closely related to *Procolophon*. They were low, clumsy, crawling reptiles, large headed, with very primitive skull construction, pectoral girdle very primitive except for absence of cleithrum, 22–24 thoracic vertebræ, no intercentra, imperfectly double-headed ribs, some ventral armature, and very primitive, flat, plate-like pelvis. The phalangeal formula is not yet proved; there is no evidence as yet of the chelonian formula in any Permian reptile, and it is probably derived from the older formula with more numerous phalanges; the cervical vertebræ are short and few in number; the animal had practically no neck, as in the contemporary amphibians. The characters of *Lysorophus* have been stated in a recent publication by Dr. Williston; an important discovery is of evidence that it possessed completely formed limbs, although of small relative size.

Discussion: Dr. E. C. Case observed in regard to the abdominal ribs of the Pariotichidæ, that they were present in certain specimens discovered by him last summer. The absence of intercentra was confirmed and its significance considered. The essential similarity, aside from a few highly specialized characters, of all these Permian forms as noted by Dr. Williston, is only explainable as a retention of primitive characters.

This paper was followed by "Notes on a Collecting Trip in the Permian of Texas, during the Summer of 1908," by Dr. E. C. Case. The author discussed the stratigraphy and conditions of deposition of the Texas red beds. No very satisfactory arrangement of these strata has yet been made. Professor Cummins's earlier arrangement was into (1) Wichita, (2) Clear Fork, (3) Double Mountain, successively overlying the Albany limestones, the Clear Fork being the chief fossiliferous horizon. The first two divisions are not clearly separable in Dr. Case's opinion. The succession in the part of the region studied by him was as follows:

(4) Conglomerate and sandstone layer similar to that below.

(3) Red clay, about 20 feet.

(2) Conglomerate layer, varying to a cross-bedded sandstone.

(1) Red clays.

The upper conglomerate forms the top of the country in the eastern part of the region. The sandstone is composed of æolian sand, the conglomerate of rather angulate pebbles. West of Dundee the upper and lower conglomerate members come together and at the junction is a heavy bone-bed. West of this comes in a new conglomerate layer. The strata were regarded as deposited along a lagoon-coast into which were washed the remains of animals and sediment from the dry land. They are not, strictly speaking, estuarine. Little is yet known of the geographic or geologic distribution of the fauna. The genus *Diplocaulus*, abundant north of the Wichita, has not been found south of it. Remains of insects—two well-preserved wings—were discovered by Dr. Case last summer, their first discovery in this fauna. Other interesting discoveries were a new reptile of small size and a new amphibian allied to *Zatrachys* or *Aspidosaurus*.

Discussion: Dr. Williston inquired whether the author considered that these beds indicated arid climatic conditions. Dr. Case: The beds themselves probably not, but the back country may have been arid; the bones occur chiefly in the conglomerate; in the clays they are very rare, but when found are apt to be articulated skeletons. This fauna was at least in part made up of dry land animals; the construction of the feet in *Dimetrodon* and *Naosaurus* is evidence for this view.

Dr. Gordon took some exception to the author's explanation of the stratigraphy, and discussed the relations of the sandstone layers. Dr. Williston observed that his experience last summer confirmed the general accuracy of Dr. Case's stratigraphy, but that river channels appeared to be more abundant; he illustrated a typical example which he had noted.

Dr. Gordon further discussed the paper, pointing out that the so-called Permian red beds of this region are in fact a northward continuation of the Albany limestone itself, instead of an overlying formation. This had been suspected by Dr. Cummins himself in the later years of his work.

Dr. David White discussed the relations of the plants of the formation and its geological age. In his opinion, it is probably Permian and not Carboniferous. The evidence of aridity did not seem very convincing. Dr. Gordon: As originally applied the Clear Fork and Double Mountain formations do really overlie the Albany. The mistake in Dr. Cummins's stratigraphy lay in his extending the Clear Fork eastward into Baylor County.

The president then called for the paper by Dr. Dean.

The author showed a series of micro-photographs illustrating the remarkable preservation of the muscular tissue in the fossil sharks of the

Cleveland shale, and remarked upon its rarity and interest. The striation of the muscular fiber could be clearly observed. In one specimen the form and structure of the kidneys of both sides were shown.

The next paper was by Dr. Matthew, on a skull of *Apternodus* and skeleton of a new Artiodactyl from the lower Oligocene of Wyoming. The specimens in question were obtained for the University of Wyoming by Mr. W. H. Reed, to whose courtesy and to the good offices of Dr. Williston the author owed the privilege of description. The *Apternodus* is an Insectivore of the rare and primitive Zalambdodont division; it is the third and most complete fossil skull referable to this group. The structure is peculiar in several respects, but its nearest relationships appear to be with the Centetidæ of Madagascar. It affords some interesting data bearing upon the hypotheses regarding the origin of the tritubercular molar of mammalia. The second specimen represents a new stage of the Camel phylum, intermediate in most respects between *Protylopus* of the upper Eocene and *Paratylopus* and *Poëbrotherium* of the middle Oligocene, but nearer to the former genus. The lateral digits of the fore feet are complete but slender; those of the hind feet are reduced to nodular rudiments. The proportions of the limbs, feet, skull and neck are as in *Protylopus*, lacking the elongate proportions of all the later camels; the tympanic bulla is of camelid type. The molar teeth are very short crowned and the upper molars peculiar in the development of a strong additional crest on the anterior wing of the posterior inner crescent. This crest is feebly developed in certain Giraffidæ, not known in other artiodactyla. Except in this peculiar feature the new genus represents very satisfactorily the lower Oligocene stage in the evolution of the Camelidæ.

The next paper was by Dr. Loomis upon the "Camels of the Lower Miocene." The author recognized two aberrant lines of camels, one represented by *Stenomylus*, the other by *Oxydactylus*, besides the more direct line of descent, imperfectly known at this stage of its evolution. A new species of *Stenomylus* was indicated by the series of complete skeletons found at the Amherst quarry, in which the premolars are further reduced than in the type of the genus. The author also showed drawings of a new species of peccary from this horizon.

The paper was discussed by Messrs. Cook, Matthew and Riggs.

Dr. E. S. Riggs then presented the results of his observations upon the Loup Fork beds of eastern Wyoming. The author had adopted in general the classification given by Mr. Hatcher. The Monroe Creek beds he had found hardly distinguishable from the Harrison and generally very barren. The Harrison beds are fossiliferous. The correlation between certain types of sediment and certain faunal groups of animals was noted. The strata were probably deposited by rivers in an open plains country. A list of the principal fossils was given, and the origin of the Dæmonelix beds was discussed at some length. The author had found remains of five different species of animals associated with the Dæmonelix spirals, *viz.*, skulls and skeletons of *Steneofiber*, skeletons of two genera of carnivora, a jaw of *Merychyus*, and parts of the skeleton of *Oxydactylus*. The last was partly without and partly within the spirals and the parts within had apparently been absorbed or eaten away. The other fossils lay completely within the spirals. Photographs of one of the carnivore skeletons were shown; the animal appeared to be coiled up in a natural position, as though resting upon a bed of sand within the cavity. It was concluded that at some stage of their formation these spirals had been open holes, but their mode of origin was still obscure. If they originated as burrows their formation must be ascribed to one only of the several animals found in them. In connection with a possible vegetable origin attention was drawn to the spirally coiled lianas common in tropical forests. These if buried in sand might decay and leave an open hole.

The paper was discussed by Messrs. Cook, Loomis and Matthew with regard to the correlation of the Harrison beds and the origin of Dæmonelix.

After which the meeting adjourned to 3:15 P.M.

The first paper of the afternoon session was by Dr. D. Matthew and Harold Cook, on a "Pliocene Fauna from Western Nebraska." The fossils described were from deposits lying just south of the divide between the Niobrara and North Platte Rivers in Sioux County, Nebraska, a new locality discovered by the authors last summer while prospecting in the interests of the American Museum of Natural History. The formation appeared to be a marginal phase of the Ogalalla formation, and had been largely removed by æolian action, leaving in places only a residuum of gravels and coarser deposits of old channel beds, mantling the eroded surface of the Miocene beds. At other points the upper formation was more or less intact, and easily distinguished by the prevalence of true quartz sands and gravels of metamorphic and crystalline rocks. With the residual gravels of

the channel beds were great numbers of bones and teeth, mostly fragmentary and waterworn, but indicating a large and varied fauna. More than sixty species are represented by our collections, of which a considerable part are clearly new. Horses are the most abundant fossils, some hundreds of jaw-fragments and about ten thousand separate teeth being in the collection. All these belong to the Protohippine group, and are closely allied to those of the upper Miocene, but in some cases more specialized. *Equus* does not occur. A large variety of camels is present, some of gigantic size. The deer-antelope *Meryoodus* is common, along with several kinds of true deer. The presence of true antelopes of the *Tragocerus* group is indicated by a horn, several upper jaws, teeth and skeleton bones. A single lower jaw is referable to the genus *Bison*, but its pertinence to this fauna is questioned. There are also several species of Oreodonts with a more advanced type of dentition than any described genera. Advanced species of the rhinoceros genera *Teleoceras* and *Aphelops* are present, and a Proboscidean of undetermined genus. The presence of Edentata is indicated by a single imperfect claw. Peccaries, several genera of rodents, and more than a dozen different Carnivora are represented. Most of them belong to known upper Miocene genera, but in several instances the species are more highly specialized. One lower jaw represents the modern genus *Bassariscus*, not heretofore known fossil. The age of the fauna is regarded as lower Pliocene, and the nearest comparisons are with the fauna of the Alachua clays of Florida and the Rattlesnake beds of Oregon.

In the underlying beds were found several skeletons of *Merychippus* and other genera, indicating that they are of middle Miocene age, equivalent to the Pawnee Creek beds of Colorado, and later than any of the Miocene beds in the Niobrara Valley to the north of them.

Discussion: Mr. Riggs observed that he had seen similar cases of residual deposits of bones in eastern Wyoming last summer.

Dr. Loomis remarked on the extraordinary abundance of animal remains gathered together within a small space at this locality.

Mr. Gidley observed upon the highly specialized character of the horses, which he thought compared most nearly with those of the Archer beds (Alachua clays).

Mr. Hussakof's paper then followed, "On a Method of Arranging Large Study Collections in Museums." The author described the methods of arranging the fossil fish collections in the American Museum. They are placed in shallow trays in racks, an arrangement first introduced by Darwin. He advocated an arrangement primarily zoological, with a subordinate arrangement in alphabetic order. Special collections could be kept apart until studied and then merged in the general series. Space could be left for the addition of new material to the collections without disarranging the order. The paper was discussed by Mr. Gidley and Dr. Matthew.

The next paper was by E. B. Branson, "Notes on some Dinichthyids from northern Ohio." The author described a number of specimens of Dinichthyids recently collected for the museum of Oberlin College, including a fine skull of *D. intermedius* and a number of jaws and skull plates apparently of undescribed species. He also called attention to a specimen of Amphibian foot-prints from the Mauch Chunk shales of Pennsylvania.

Discussion: Dr. Hussakof inquired in regard to the occurrence of *D. intermedius* in the Delaware limestone as reported by Mr. Branson, and expressed some doubt as to the certainty of the horizon. He also noted the variable character of the mandible in the species of *Dinichthys*.

Mr. Branson, in reply, stated that there was no doubt as to the specimen in question being in place in the Delaware limestone.

The session was then adjourned.

On Wednesday, December 30, the society reconvened at 10 A.M. and proceeded with the program of papers.

Professor Osborn explained the plans of the International Committee on Geologic Correlation of the National Academy of Sciences. Professor Williston expressed his sense of the importance and desirability of the work as outlined. Dr. Loomis pointed out the need for field sections in the collecting of fossil vertebrates.

Professor Osborn then gave a preliminary report upon the skeleton of *Trachodon* discovered by Mr. Sternberg last summer. The specimen is articulated and complete except for the tail and hind feet. Careful preparation at the American Museum indicates that almost the whole integument is preserved, and the author described its character and pattern. The specimen was probably naturally mummified, and then buried by a mass of sand from a freshet. This skeleton, aside from its extraordinary interest in the preservation of the integument, will add considerably to our knowledge of the osteology of *Trachodon*, especially as regards the shoulder-girdle and its relations to the sternum and ribs. The paper was

illustrated by several slides, showing the locality and stages in the excavation of the specimen.

Professor Osborn then gave a brief description of the Cretaceous section in Montana in which the skeleton of *Tyrannosaurus* was found last summer, pointing out the sharp faunal distinction between the true Cretaceous and the Eocene part of the section.

Discussion: Professor Lull inquired whether this specimen throws any further light upon the supposed aquatic habits of *Trachodon*.

Professor Osborn replied that in general the view that these animals were waders rather than truly aquatic, appeared to be the most probable.

Dr. Williston inquired as to whether any carbon was preserved in the skin, as it is in so many instances in the Kansas chalk. He also recalled that in the excavation of the type specimen of *Morosaurus grandis* in 1878, considerable parts of the skin were found to be present in the form of a rather thick carbonaceous sheet. Owing to the unfavorable conditions, it was not then possible to preserve any part of the skin. He pointed out additional reasons against believing that the Dinosaurs were aquatic animals.

The problem of the habitat of the Sauropodous Dinosaurs was further discussed by Dr. Matthew, Dr. Williston, Mr. Riggs, Professor Lull and Mr. Gidley. Dr. Williston and Mr. Riggs advocated a terrestrial, Dr. Matthew and Mr. Gidley a wading, habit for this group.

In absence of Professor Osborn, Dr. Matthew then reported briefly upon the *Bison latifrons* skull recently acquired by the American Museum. This is believed to be the finest fossil bison skull on record. It measures nearly six feet from tip to tip of the horn-coves; the skull is but slightly larger than that of *B. americanus*, but shows several differences in form. It was discovered some years ago near Hoxie, in northwestern Kansas.

Discussion: Dr. Case mentioned a fine fossil bison skull in the collection of Iowa University. Dr. Williston observed that there was a very fine skull in the Leland Stanford University collections. It had not, he believed, been mentioned in print. He further discussed the characters of the different species of *Bison* and the geological horizon of *B. alleni*, reported by Marsh as Pliocene but probably Pleistocene. The living species *B. americanus* is also found in the late Pleistocene.

The program of papers being completed, the business meeting of the society followed.

The nominating committee reported that they had agreed upon the names of Dr. J. C. Merriam for president and Mr. E. S. Riggs for secretary and treasurer. These nominations were accepted by the society and Messrs. J. W. Gidley, Barnum Brown and F. B. Loomis were then nominated as executive committee, and there being no further nominations, the secretary was instructed to cast a ballot for the nominees, and they were duly elected.

It was further resolved that the secretary with an assistant from the executive committee should have charge of the arrangement of program for the ensuing meetings, to avoid conflict with the programs of related societies whose meetings the members might wish to attend.

The following gentlemen were then proposed for membership: Professor E. R. Branson, Oberlin College, Ohio; Dr. Roy L. Moodie, Kansas University; Mr. W. H. Reed, University of Wyoming; Mr. C. H. Sternberg, Lawrence, Kansas; Professor C. E. McClung, Kansas University. After each name had been individually balloted upon, the president declared the unanimous election of all to membership in the society.

On motion of Dr. Loomis the following resolution was passed:

Resolved, That the American Society of Vertebrate Paleontologists, having found the "Bibliography and Catalogue of Fossil Vertebrates of North America," issued as a bulletin of the U. S. Geological Survey, of the greatest service in expediting research, do hereby request the director of the survey to prepare and publish a supplement to the same, to include the bibliography from 1900 to 1910, and do respectfully tender all assistance possible.

It was then resolved that the society express its appreciation and thanks to Professor Clarke and the Johns Hopkins University for their courtesies and efforts which had done so much to promote the success of the Baltimore meeting.

After which the society adjourned.

W. D. MATTHEW,
Secretary

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 209th meeting of the society, held at the Cosmos Club, on Wednesday evening, November 11, 1908, Mr. Willis T. Lee spoke informally on an occurrence of coal changed to coke and graphite in the Raton, New Mexico, coal field.

During some period of volcanic activity after the coal beds had been formed igneous rock was

intruded into the beds. In some places this took the form of dikes, such as the "stone wall" at Raton; in other places it formed intrusive sheets thrust in between the beds. Where a comparatively small amount of this melted rock came in contact with the coal it changed the coal to coke, but where a large amount was injected the greater heat transformed the coal into graphite. This transformation was effected over an area of several hundred acres in Red River Valley.

Regular Program

Results of a Geodetic Study of the San Francisco Earthquake: Mr. JOHN F. HAYFORD.

The report of the California State Earthquake Investigation Commission is now being published by the Carnegie Institution. It includes a paper prepared by Messrs. Hayford and Baldwin, of the Coast and Geodetic Survey, giving the permanent displacements detected at sixty-one old triangulation stations, by new triangulation after the earthquake.

The permanent displacements to the northward on the west side and to the southward on the east side of the fault are greatest at the fault, and are nearly or quite parallel to it. On either side of the fault the permanent displacements decrease with increase of distance from the fault in such a way that lines on the surface of the ground and at right angles to the fault, which were straight before the earthquake, became curved lines after the earthquake, concave to the southward east of the fault and concave to the northward west of the fault.

At corresponding distances from the fault, especially near it, the displacements on the western side of the fault are twice as great, on an average, as those on the eastern side.

Mr. Hayford presented some considerations which lead him to believe that in such an earthquake the fault along which the displacements take place should not be expected to lie in the middle of the area which was under stress before the earthquake and the displacements should not be expected to be equal on the two sides of the fault.

Ordovician Paleogeography: Mr. E. O. ULRICH.

Mr. Ulrich exhibited paleogeographic maps of North America showing four stages of the Mohawkian epoch. Their explanation was preceded by a brief discussion of the classes of evidence available in paleogeographic studies. Roughly divided the facts bearing more or less directly upon paleogeography comprise two main classes: (1) organic (composition and distribution of faunas and floras) and (2) physical (phenomena of stratigraphic overlap, character and distribution, with respect to known lands and seas, of the various kinds of deposits, marine and nonmarine).

The presence and direction of ancient marine currents is determined primarily by organic criteria, but in a few cases their evidence is materially corroborated by facts falling under the physical class. It was pointed out, on the other hand, that the physical criteria of stratigraphic overlaps are but rarely sufficiently conclusive by themselves. As a rule they require the corroborative evidence of organisms before the overlaps may be accepted as established. In many cases also the overlap was originally suggested by purely paleontologic evidence, the physical evidence being so obscure that it is easily overlooked.

Further, it was pointed out that the physical criteria indicating coasts, especially of Paleozoic lands, are often exceedingly inconspicuous. Indubitable instances were cited of near-shore sedimentation, in seas submerging old lands, the true significance of which might perhaps never have been recognized if the beds had been unfossiliferous.

The first step in the preparation of paleogeographic maps is the solution of approximately synchronous facts. These must be primarily only organic. With such parts as a basis and check we may use orogenic movements which resulted in the emergences or submergences of large epicontinental areas. These movements are chronicled by the rocks and fossils, but it is the paleontologist alone who is responsible for their chronologic classification. Indeed, the determination of the relative age of geologic phenomena, hence the solutions of facts that may be reasonably assumed to be approximately synchronous, is the paleontologist's principal excuse for being. Considering his long training he may justly claim to have become an expert in such solution; and it is an undeserved reflection on his intelligence and attainments when a non-paleontologist says that a "New York formation can not be narrowly correlated with an equivalent in the Mississippi Valley," and that "the data of paleogeography do not admit of refined definition."

In the speaker's estimation the relative competency of the two classes of evidence, organic and physical, is, respectively, as four is to one; and that the latter without the support of highly

refined paleontologic data is as a ship devoid of rudder and skipper. It was further asserted that the "autocratic dicta" of the successful stratigraphic paleontologist of to-day are not based solely on comparisons of lists and collections of fossils but upon every physical fact that may have a bearing on the variation, horizontal and vertical, of faunas and floras. Obviously then, only an up to date paleontologist is equipped to produce a good paleogeographic map.

RALPH ARNOLD,
Secretary

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

THE thirty-first meeting of the society was held at the Rockefeller Institute for Medical Research, December 16, 1908, with President Lee in the chair.

Members present: Atkinson, Auer, Beebe, Burton-Opitz, Calkins, Carrel, Clowes, Elsberg, Emerson, Ewing, Famulener, Foster, Gies, Halsted, Hatcher, Jacobs, Janeway, Joseph, Kast, Lee, Levene, Levin, Lewis, Lusk, Meltzer, Meyer, Morgan, Noguchi, Opie, Pearce, Sherman, Terry, Torrey, Van Slyke, Wadsworth, Weil, Wood.

Members elected: Albert C. Crawford, W. H. Schultz and Thomas A. Storey.

Scientific Program[1]

John C. Hemmeter (by invitation): Reply and explanation to recent criticism of Dr. Hemmeter's experimental study on effects of extirpation of the salivary glands upon the gastric secretion.

G. H. A. Clowes: A critical study of the conditions under which zymase and its associated co-enzyme bring about alcoholic fermentation.

Alexis Carrel: Presentation of a dog ten months after double nephrectomy and replantation of one kidney.

Don R. Joseph and S. J. Meltzer: A demonstration of the life-saving action of eserin in poisoning by magnesium.

A. O. Shaklee and S. J. Meltzer: The mechanical destruction of pepsin.

John Auer: A demonstration of the effects of CO_2 upon the frog's pupil.

[1] Authors' abstracts of the papers read before the Society for Experimental Biology and Medicine are published in the *Proceedings of the Society for Experimental Biology and Medicine.* A number is issued shortly after each meeting, and costs twenty cents a copy. Copies may be obtained from the managing editor, William J. Gies, 437 West 59th Street, New York.

Richard Weil: On the specific acquired resistance of red blood cells.

Hideyo Noguchi: The butyric acid reaction for syphilis in man and in the monkey.

D. D. Van Slyke and P. A. Levene: The quantitative separation of leucin from valin.

W. A. Jacobs and P. A. Levene: Further studies on the constitution of inosinic acid.

Ralph S. Lillie: The significance of changes in the permeability of the plasma membrane of the living cell in the processes of stimulation and contraction.

F. C. Becht and J. R. Greer (by invitation): On the relative concentration of lysins, precipitins, agglutinins, opsonins and related substances in the different body fluids of normal and immune animals.

Nellis B. Foster: Studies of the influence of various dietary conditions on physiological resistance. I. The influence of different proportions of protein in the food on resistance to the toxicity of ricin and on recuperation from hemorrhage.

WILLIAM J. GIES,
Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

THE fourth regular meeting of the session of 1908-9 was held at the Chemists' Club on January 8.

Mr. Frank Gottsch presented "A Simple Specific Gravity Apparatus for Portland Cement." His method, which he illustrated by a determination on the lecture table, depends upon the weight of cement required to replace a measured volume of kerosene removed from a graduated flask. It is rapid and gives results sufficiently accurate for commercial work.

The rest of the evening was devoted to the general subject: "The United States Patent Law: Its Use and Abuse." The speakers and their titles were:

F. I. Allen: "Introduction: Historical and Descriptive."

W. Hastings Swenarton: "Patents, Trade Secrets and Trade Names as Factors in Industrial Development—Their Relative Functions."

L. C. Raegener: "Some Defects in the Practise of Our Patent System and Suggested Remedies."

B. C. Hesse: "Some Suggestions as to Desirable Improvements."

L. H. Baekeland: "The Inventor's Standpoint."

C. M. JOYCE,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 5, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE STUDY OF IGNEOUS ROCKS[1]

No branch of petrology presents so attractive a field for investigation and study as that concerned with the origin and formation of igneous rocks. The great problems of metamorphism that traverse so much of the earth's dynamic history and involve so many factors common to the problems of igneous rocks are less alluring because of their greater complexity, and less definite character. While much is being done in each of these fields of rock study, it is to the former that I wish to call attention at this time. It is interesting to note how the attitude of the petrographer toward the subject of igneous rocks has changed with increasing knowledge of their composition, and with advancing experience with the fundamental laws of physics and chemistry.

Rocks that were considered igneous a century ago were almost wholly those known to have poured forth from volcanic craters, and were, for the most part, compact, aphanitic lavas, often containing porphyritic crystals—distinctly volcanic rocks. The great number of phanerocrystalline massive rocks were not generally considered as having the same character and origin as volcanic rocks, as being igneous. Their formation was explained in different ways by various geologists. And when treated

[1] Address of the vice-president and chairman of Section E—Geology and Geography—American Association for the Advancement of Science, Baltimore, 1908.

as "plutonic," were still thought of as different from "volcanic" rocks. Some of the commonest were considered as extreme forms of metamorphism, and have been so treated until quite recent times by eminent geologists.

Not only the geological mode of occurrence of many of these rocks was unknown, or only partially known, but the inherent, material characters were often matters of conjecture. Before the introduction of the microscope by Sorby, in 1850, the mineralogical study was confined to the larger, megascopic crystals, except for the microscopical investigation of rock fragments and powder by Cordier in the first decade of the last century. And the early chemical analysis of rocks, while adding considerably to a knowledge of their composition as a whole, lacked the completeness and accuracy of modern analytical methods, and failed to explain the composition of the rocks because of the absence of satisfactory knowledge of the mineral components.

With improved methods of investigation, geological, mineralogical and chemical, knowledge of the character and composition of rocks advanced. The supposed distinction between "volcanic" and "plutonic" broke down, or assumed new definition, through the observations and writings of Judd and others. The term "igneous rocks" came into more general use, and embraced all "volcanic" and "plutonic" masses. The mineral composition of all crystallized igneous rocks became known in more and more exact terms, though much remains at present to be learned of the definite chemical composition of some of the common mineral components of most rocks. Chemical analyses of rocks are becoming more complete, and more frequent in petrographical publications, and the store of chemical data is steadily increasing and has been made more available by the collections of rock analyses published by Roth and more recently by Washington.

The description of igneous rocks has been largely fortuitous. As rocks happen to have been encountered in geological field work, they were collected, and not always with due regard to their geological relations to other rock bodies; and subsequently they were investigated in the laboratory, more or less thoroughly, and described, often very imperfectly. Up to recent times the terms "petrography" and "petrographer" applied satisfactorily to the subject and to the worker in it, for the work was chiefly descriptive.

Generalizations regarding the nature of igneous rocks, or the formulation of laws controlling their crystallization, were largely empirical dicta not infrequently based on incomplete knowledge or inadequate experience. As a natural consequence of the haphazard manner of growth of the science, there has been an unsystematic nomenclature, derived from many sources at widely remote times, expressing markedly different degrees of information regarding the thing described—rock, texture or relationship—and in many instances representing in a single term a series of definitions varying with shifting opinion or advancing knowledge. Such, for example, as syenite, granite and trachyte.

At the present time attempts are being made to apply to the study of igneous rocks the results of laboratory experience in physical chemistry and, not only to investigate directly the physical behavior of molten rock minerals singly and in combinations, or mixtures, but to apply the more advanced laws of physicochemical reactions to the elucidation of the problems of crystallization, differentiation and mineral composition. The researches of Day and his colleagues in the geophysical laboratory of the Carnegie Institution of Washington, D. C., upon temperatures of

fusion, crystallization, and transformation points of silicate compounds corresponding to rock minerals, and of the behavior of mixtures of pairs of such compounds in producing mixed crystals, new compounds or eutectic mixtures, are of the first importance. The accuracy of the methods employed and the thoroughness of the work guarantee the value of the results and their permanency. In addition to the establishment of improved, or entirely new, methods of operation of a purely physical character tributary to the study of petrological problems, they have determined the isomorphism and physical behavior of the lime-soda-feldspar series; the relations of the various lime-silica compounds to one another; those of the lime-magnesia-metasilicate series; the melting and transition points of quartz and tridymite, and the character of still other compounds, and they have materially extended our knowledge of solid solutions.

Doelter and his pupils have studied the fusibility of the rock minerals and their solubility in one another, but the methods employed are less accurate than those just mentioned and involve a large element of subjectivity. They are approximations to the facts desired, often of much value qualitatively, but sometimes misleading. Other recent and valuable qualitative work in this field has been done by Morozewicz, while earlier work is represented by the classic researches of Daubrée, Fouqué, Michel-Lévy and others.

The most obvious result of the earlier efforts was the demonstration of the adequacy of fusion and gradual cooling, at ordinary atmospheric pressures, to bring about the crystallization of many minerals found in igneous rocks; and the necessity of some catalytic agency to promote the crystallization of other minerals common to these rocks. Such actions were ascribed to "*mineralizing agents*," or "crystallizers," assumed to be in most instances dissolved gases, chiefly H_2O. One of the most significant facts brought to light by the researches of Day and his colleagues is the new conception of high viscosity found in alkali-feldspars and quartz. Viscosities so great at temperatures near the transition point of liquid to crystal phase as to be indistinguishable within the two phases. That is, the viscosities of the amorphous glass and of the crystallized mineral are so nearly identical that the two phases of the substance react alike toward mechanical stress. Molecular mobility is so slight that readjustment from crystalline arrangement to the homogeneous chaos of liquid molecules is accomplished with such extreme slowness that the time of ordinary laboratory observation is not sufficient for its detection. However, the time available for ordinary "geological" processes, so called, is sufficient, as shown by the devitrification of volcanic glasses composed of these constituents—ancient rhyolitic obsidians. The function of a catalytic agent, as a gas dissolved in such a viscous liquid, is obvious—the viscosity is reduced and molecular mobility increased. If the transition is toward the liquid phase, solubility of the crystal is increased. If it is toward the crystal phase, the rate at which crystallographic molecular arrangement is accomplished is increased. The dissolved gas becomes a "crystallizer," or "mineralizing agent." Other substances, such as mineral compounds, yielding less viscous liquids than those of the alkali-feldspars and quartz, when dissolved in the more viscous liquids, reduce their viscosity in the same manner, though not to the same extent, as dissolved gases. They must behave catalytically toward crystallization, as gases do. Their behavior in this respect has not been generally recognized, though the function of certain liquid compounds, as fluxes, or as "mineralizing agents," is well known.

Thus the improvement in methods of

physical research is steadily enlarging the field of petrological investigation, and the advancement in the knowledge of physicochemical laws is furnishing the investigator with new tools for the work and more efficient means for attacking the problems of igneous rocks. Foremost in the ranks of those who have attempted the application of modern conceptions of physical chemistry to the elucidation of the phenomena of texture and mineral composition and of the genetic relationships of igneous rocks is Vogt, whose earlier studies of furnace slags opened the way for the explanation of many analogous phenomena in the more refractory, volcanic lavas. Chief among these are the apparent order of crystallization of different minerals in slags, as indicated by their shapes and relations to one another as inclusions, and the relation between these orders and the composition of the mixture from which they crystallized. Vogt's observations were found to be in accord with modern theories of solutions, as Bunsen foretold in 1861, when he affirmed his belief that rock magmas are solutions of silicate compounds liquid at high temperatures. Vogt has called the attention of petrologists to these modern theories as developed by Arrhenius, van't Hoff, Ostwald, Gibbs, Meyerhoffer, Roozeboom and others. He has also made definite application of them to some of the phenomena and relationships mentioned. His publications have extended widely the horizon of modern petrology, which by the assumption of these broader, deeper phases of the study of igneous rocks, and of similar problems affecting metamorphic rocks, has passed beyond the narrower boundary of petrography, strictly so called.

The evolution of chemistry from a state of pure empiricism to one of comparatively logical sequence has placed before us a collection of coordinated laws, which, while incomplete, or subject to numerous exceptions, furnishes us with means to postulate reactions between the constituent elements of rock magmas with reasonable assurance of correctness, or to explain the formation of mineral compounds hitherto in a measure enigmatical. Much remains to be more firmly established, both as to the chemical character of the elements and their compounds, and with regard to theories relating to their reactions, and even to the very nature of their existence in some instances. The silicate compounds constituting igneous rocks remain largely uninvestigated, so far as concerns their synthesis and reactions in mutual solution. And the physical study of solutions and of their transitions to the solidified components—especially the more complex mixtures—is far from completed. The present is a period of transition in the development of petrology, as were also times past. But the changes taking place at this time appear to be so many and so fundamental that it may well be asked whether the older methods of approach to the study of igneous rocks should not be replaced by others more in accord with present conditions of knowledge of chemistry, physics and of the rocks themselves. The older method, in the nature of things, was, and is largely at the present day, objective, and the expressions of relationships or laws empirical.

It would seem more reasonable to begin a systematic study of igneous rocks with a consideration: of the most fundamental characteristics of the magmas from which they have solidified; of their constituents, together with their probable chemical reactions and the resulting mineral compounds; of the manner in which these may separate from a silicate solution, or rock magma; of the shapes they are likely to assume upon crystallization and the consequent texture of the rock. Processes of molecular separation of magmas lead to the discussion of the differentiation of magma into chem-

ically unlike parts and the resulting different varieties of igneous rocks, together with their eruption and solidification as geological bodies of various kinds.

Assuming a certain elementary acquaintance with rocks on the part of the student, which is acquired in courses in general geology, the systematic treatment of the subject should begin by calling attention to the chemical composition of unaltered igneous rock as shown by analyses, published in many descriptions of rocks, but most conveniently found in comprehensive collections in Bulletins of the U. S. Geological Survey and in the tables of analyses edited by Justus Roth and more recently by H. S. Washington. The extremely variable nature of these data and their great abundance present such an exceedingly complex set of numerical relations that their statement, or discussion, requires the aid of diagrams by which the problem may be greatly simplified.

In addition to the chemical elements noted in ordinary rock analyses there is a much greater number known to occur in rare minerals that crystallize from rock magmas in special instances, or that oftener appear in certain varieties of igneous rocks, such as the pegmatites. A consideration of all known pyrogenetic minerals with respect to their chemical composition calls attention to the compounds that are repeatedly formed in igneous magmas by the union of the elements that existed in the magmas before their solidification. And by arranging them in accordance with the order of their constituent elements in the Mendeléeff series valuable information as to certain chemical relationships among these compounds is at once furnished.

The substances occurring in igneous rocks are in most cases solids, less often liquids or gases. The solid compounds are always in crystallized condition. Amorphous, glassy solids that sometimes occur in igneous rocks are seldom, if ever, definite chemical compounds, but are mixtures. The crystallized substances (minerals) are rarely present as uncombined elements, such as gold, graphite and metallic iron. A few are simple compounds with invariable composition, as SiO_2 (quartz), TiO_2 (rutile), Al_2O_3 (corundum). Most of them are complex and variable in composition, owing to the presence of isomorphous mixtures, as the feldspars, olivine, amphiboles. There are very few examples of polymorphism, such as quartz and tridymite. The apparent difference in the crystallization of orthoclase and microcline is probably due to submicroscopic multiple twinning in the apparently more symmetrical form. Polymorphism of some of the pyrogenetic compounds, as $MgSiO_3$ and $CaSiO_3$, which is known in laboratory products is not clearly developed in pyrogenetic minerals.

Certain isomorphous mineral compounds are not developed in igneous magmas with like frequency, or in certain cases not at all. Such, for example, are the hexagonal compounds $NaAlSiO_4$ (sodium-nephelite), $KAlSiO_4$ (kaliophilite), $LiAlSiO_4$ (eucryptite). Compare also the potash-, lithia- and soda-micas. Other compounds that are analogous chemically and might be expected to crystallize isomorphously in igneous magmas have quite different crystal symmetry, as is the case with $KAl(SiO_3)_2$ (leucite), $NaAl(SiO_3)_2$ (jadeite), $LiAl(SiO_3)_2$ (spodumene).

Various silicate compounds involving different silicic acids: orthosilicic, metasilicic, polysilicic and in rare instances disilicic, besides uncombined silica, may crystallize from the same rock magma. And even base-forming elements, as iron and aluminium, may, under some conditions, separate from rock magmas as oxides without combining with silica, which may itself separate as SiO_2. That is, hematite, magnetite or corundum may crystallize in the pres-

ence of quartz. On the other hand, certain lower silicates do not form when there is sufficient silica to form higher silicates with the same bases. Thus $KAl(SiO_3)_2$ (leucite) and $NaAlSiO_4$ (nephelite) do not occur pyrogenetically with SiO_2 (quartz).

Moreover, it is well known that some rock magmas, especially those of intermediate composition, crystallize under one set of conditions into certain combinations of minerals, and under others into other combinations, certain minerals appearing in one case and not in another, though the magmas from which they formed were chemically alike.

In order to account for the production of the mineral compounds known to occur in igneous rocks, as well as for the absence of others; and to understand the possibility of variation in the production of mineral compounds from any magma under variable conditions; and to comprehend the act of separation and crystallization of such minerals upon the solidification of the magma; it is necessary to consider the probable physical and chemical character of liquid rock magmas, especially the known physicochemical laws regarding solutions.

Discussions of the behavior of solutions under varying conditions of temperature and pressure involve theories of the possible molecular constitution of matter, gaseous, liquid and solid, which must be kept in mind in order to form any clear conception of the processes under consideration. The kinetic theory regarding the behavior of molecules of gas, liquid or solid, under variable temperatures and pressures, furnishes definite pictures of changes of state at transition points from one phase to another. Those with which the problems before us are most concerned are the critical point of gases, the melting point of solids, the solution or the separation points of solids in liquids and also the transition point between two crystal phases of the same compound (such as that between quartz and tridymite).

Since liquid rock magmas are solutions of silicate compounds in one another, all that is known of the physical and chemical behavior of solutions is germane to the discussion. This includes the solution of gases, liquids and solids, in liquids; and eventually their solution in solids; the solubility of various substances in liquids of other substances; the possible molecular constitution of liquid solutions; the existence of molecules of different degrees of complexity, and the dissociation or ionization of some compound molecules; the laws relating to diffusion, and the relative diffusibility of various compounds; those relating to the molecular concentration—the saturation and supersaturation of solutions. The chief qualifying factors in this discussion are the chemical composition of the several compounds; the possibility of changes in chemical equilibria; the viscosity of the solution; the temperature, pressure and the time through which any operation acts. The possibility of producing in a colloidal condition one of the compounds, $Al(OH)_3$, $Fe(OH)_3$ or $Si(OH)_4$, by the interaction of the hydroxyl (OH) and aluminium (Al), iron (Fe), or silicon (Si), is also to be taken into consideration.

In a solution containing the chemical elements common to igneous rocks reactions should take place between them in accordance with known chemical laws, and with results corresponding to observed pyrogenetic mineral compounds. Some of the fundamental laws relating to chemical reactions among the elements are based upon conceptions of chemical energy and activity, and of the conditions that modify their effects. An important factor in chemical processes is, often, a catalytic agent that promotes reactions without itself appearing as a component of the final products. The

chemical behavior of ionic substances, and especially the hydrolyzing action of ionized water, are other factors in the problem under consideration. The relative strength of chemical activity in the base-forming, or acid-forming, elements, and their ability to form acids and salts, lead to the discussion of the production of the pyrogenetic minerals from liquid magmas composed of elements found in igneous rocks; some of these minerals having been produced in the laboratory by melting together the component elements in proper proportions.

Considering what should take place in a solution having the composition of an average of all igneous rocks, it can be shown, since the chief acid-forming elements present are silicon in large amount, and the more active element phosphorus in very small amount, that salts with these elements in the acid radical must be common. Other acid-forming elements occurring in small amounts are titanium and zirconium; while iron and aluminium may play this rôle under favorable conditions. The more active, phosphoric, acid forms unstable salts with the active base-forming metals, potassium and sodium, but a very stable compound with the less active metal, calcium, into which compound fluorine, or chlorine, enters; yielding apatite, an almost universal component of igneous rocks.

Silicon is known in the laboratory to form one definite acid, H_4SiO_4, orthosilicic acid; and other acids of silicon have not been isolated and identified. But very definite mineral compounds exist that indicate that salts from other silicic acids form under proper conditions. These are:

H_4SiO_4, orthosilicic acid;
H_2SiO_3, metasilicic acid;
$H_4Si_3O_8$, polysilicic acid;
$H_2Si_2O_5$, disilicic acid.

It is significant that in laboratory experience with orthosilicic acid, H_4SiO_4, prepared from aqueous solutions, the compound may be made to lose water gradually until nothing but silica, SiO_2, remains. In this way free silica may be separated from a silicate compound, a hydrogen silicate; since an acid may be considered as a hydrogen salt.

Observations upon the pyrogenetic minerals, and laboratory experience with synthetical operations, show that salts of several kinds of silicic acids form by the side of one another, and that their character and amount depend on the nature of the base-forming elements present in the mixed solution. Orthosilicates, metasilicates and polysilicates commonly form in the presence of one another, sometimes accompanied by uncombined silica. And it becomes more and more evident that the formation of the different kinds of silicic acid ions, or their salts, is controlled primarily by the strength, or chemical activity, of the base-forming elements; is dependent also on the amount of silica available in the solution; and may be modified, of course, by other factors. Thus it appears that the most active metals command the highest silicic ions, the highest silicates common in igneous rocks being the polysilicates of the alkalies, potassium and sodium—orthoclase and albite.

Further, the abundance of aluminium in most rock magmas results in the presence of abundant aluminous compounds. And this element, which is relatively inactive chemically, being found sometimes in the basic, sometimes in the acid radical, is oftenest combined with the strongest base-forming elements, potassium and sodium. These relations are illustrated by the following common, simple pyrogenetic minerals.

It is well known that the orthosilicate of sodium and aluminium (nephelite) and the metasilicate of potassium and aluminium (leucite) do not form in the presence of free silica (quartz), while metasilicates

Polysilicates	Metasilicates	Orthosilicates
K — Al ≡ ($_3$O N — Al ≡ (Si_3O_8) (orthoclase) (albite)	K — Al ≡ (SiO_3)$_2$ (leucite)	Na — Al ≡ (SiO_4) (nephelite)
		Al ≡ (SiO_4) Ca = Al ≡ (SiO_4) (anorthite)
	Ca (MgFe) = (SiO_3)$_2$ (diopside)	Si($_6$,)
	(Mg, Fe)$_2$ ≡ (SiO_3)$_2$ (hypersthene)	(Mg, Fe)$_2$ ≡ (SiO_4) (olivine)

and orthosilicates of the less active metals, calcium, magnesium and iron (pyroxenes, olivine and anorthite) do. The relative chemical activity of all of the elements common to igneous rocks may be illustrated in like manner, and the probabilities of various pyrogenetic mineral compounds forming from different rock magmas may be made clear.

One of the most important factors in the discussion of the chemistry of igneous rocks is the rôle of hydrogen, whether as an active base-forming element, or as a catalytic agent, alone, as hydrogen (H), or combined with oxygen, as hydroxyl (OH). Its exact behavior in each specific case is not definitely known, but the principles applicable to several distinguishable cases are clearly established.

Adopting the idea that an acid is a hydrogen salt in which hydrogen plays the rôle of a positive, base-forming element, an acid salt may be considered as one in which all of the hydrogen has not been replaced by other base-forming metals. Such an acid salt may be looked upon as a substitution derivative from a hydrogen salt (acid), or from a normal salt by the introduction of hydrogen in place of other positive metals. An example of such a compound among pyrogenetic minerals is to be found in muscovite (K, H)Al(SiO_4). This might be derived from H_4SiO_4, $KAl(SiO_4)$ or $Al_4(SiO_4)_3$. The formation of such a compound involves the presence of active hydrogen to play the rôle of metal. Muscovite is a common pyrogenetic mineral in some igneous rocks rich in silicon, with much uncombined silica, and also in others comparatively low in silica, accompanying orthosilicate and nephelite. It forms by the side of polysilicates—orthoclase and albite—and even with the disilicate, petalite. The formation of muscovite must be ascribed to the action of hydrogen upon silicon, either directly in the first instance, or, if previously formed silicates of aluminium and potassium be assumed to be the source of the compound in question, then its action in replacing part of the potassium must be that known as hydrolysis, whereby the hydrogen ions from water replace metals in the salt through a process of double decomposition.

It is known that the chemical activity of hydrogen even toward a gas, like oxygen, is greatly increased by rise of temperature; hydrogen being rather inert at ordinary temperatures. The relative activity of hydrogen and potassium toward silicon is indicated by the fact that the highest hydrogen silicate definitely known is the orthosilicate, H_4SiO_4 (orthosilicic acid), whereas potassium commonly occurs in a polysilicate, $KAlSi_3O_8$ (orthoclase). It has been found impossible to produce mica in open cru-

cibles from which hydrogen, or water vapor, naturally escapes at high temperatures. And muscovite is not formed pyrogenetically in surface lavas, or, if so, to a very small extent as compared with its occurrence in rocks crystallized under considerable pressure. From these facts it must be concluded that the formation of the acid orthosilicate (muscovite) in the presence of polysilicates and free silica must be assigned to the chemical activity of hydrogen at high temperatures under sufficient pressure to hold it in the liquid magma solution.

The same argument as to the action of hydrogen in rock magmas applies to the production of the other micas, biotites and lepidolite. These compounds are complex mixed salts, and the composition of biotite involves the production of orthosilicates of magnesium and iron, which are present in biotite. These orthosilicates develop in magmas together with metasilicates of magnesium and iron—pyroxenes and hornblende—and with uncombined silica, quartz. The same compounds when alone form olivine, which generally does not develop in magmas with uncombined silica, quartz, but probably occurs with quartz oftener than has been supposed. In both of these cases the production of orthosilicate of magnesium and iron in the presence of "free" silica in magmas in which the metasilicate might be expected to form is probably due to the hydrolyzing action of water at high temperature. That is, the hydrogen at high temperature combined with some of the silicon, that otherwise would have united with magnesium and iron as metasilicate, and formed orthosilicate of these metals and orthosilicate of hydrogen.

$$(Mg, Fe)_2(SiO_3)_2 + 2H_2O \rightleftarrows (Mg, Fe)_2(SiO_4) + H_4(SiO_4).$$

Should conditions of saturation favor the separation of the magnesium-iron compound in the solid phase, olivine would crystallize; and with falling temperature the hydrogen silicate would split up into water (H_2O) and silica (SiO_2), with the eventual crystallization of quartz.

When the amount of silica is great as compared with that of magnesium-iron orthosilicate it is possible for quartz to separate before the orthosilicate, as is the case in many hollow spherulites and lithophysæ, where fayalite, $(Fe(Mg))_2SiO_4$, is apparently almost the last mineral to crystallize, and rests upon the surface of abundant quartzes. The dependence of these forms of crystallization upon the presence of water in the magmas has been clearly demonstrated.

Other mineral compounds, whose production in igneous rocks must be referred to the hydrolyzing action of water, are amphiboles, which, as Penfield has shown, contain as an essential constituent notable amounts of hydrogen. The development of hornblende in igneous rocks appears to be dependent on conditions similar to those controlling the development of biotite, for they commonly accompany one another in rocks of intermediate composition when either is present. The particular kind of amphibole which forms in rock magmas depends primarily on the proportions of elements present, and secondarily on attendant conditions which produce variation in amphibole from one magma, which is strikingly illustrated in the two igneous rocks from Gran, Norway, described by Brögger.[3] The magmas have almost the same chemical composition, yet one crystallized into a mixture of hornblende and lime-soda-feldspar, while the other crystallized almost completely into hornblende, which contains all the components of the

[3] Brögger, W. C., "Erupt. Gest. kp. Geb.," Vol. III., 1899, p. 93, and *Quart. Jour. Geol. Soc.*, Vol. L., 1894, p. 19.

feldspar and hornblende in the first-mentioned rock.

That hornblendes are less stable compounds in igneous magmas than pyroxenes and numerous other minerals, is shown by the frequent occurrence of paramorphs of other minerals after hornblende, commonly seen in so-called black borders, and the absence of correspondingly changed crystals of other minerals.

Another chemical principle involved in the production of pyrogenetic minerals is that affecting the formation of compounds that possess common ions when in solution. It is known that when there are in a solution ions capable of entering two or more compounds, the concentration of the least soluble compound may be increased by the entrance of ions derived from other compounds into its molecules. And this may proceed to the complete incorporation of the common ions within one compound upon its separation in the solid phase. This has sometimes been called erroneously "mass action." That compound forms at the expense of another in any particular instance which is the more stable under attendant conditions. Illustrations of this action are found: in the case of the complex amphibole in the hornblendite of Gran already mentioned; in aluminous pyroxenes (augites), which contain components capable of forming lime-soda-feldspars, as pointed out by Pirsson, and in numerous other rock minerals. This principle is probably concerned in the production of the lime-soda-feldspars with notable amounts of albite molecules, as in andesine and labradorite, in magmas so low in silica as to necessitate the production of leucite from the potassium present, when the more active potassium should have combined with the silicon in a polysilicate (orthoclase), leaving the less active sodium to enter orthosilicate (nephelite).

Following out the discussion of all the probable compounds likely to form under known chemical laws from molten rock magmas upon cooling, and taking into consideration the relative chemical activities of the several constituent elements in igneous rocks, it is possible to deduce a probable mineral composition for any given magma, under given conditions of cooling. The mineral composition of igneous rocks then becomes a necessary consequence of the chemical reactions likely to obtain in molten rock magmas, and depends not only on the kinds and amounts of the elements present in each case, but also on the conditions of temperature and pressure modifying the chemical activities of the elements and the stability of the compounds. As these conditions are known to vary with the experience of different magmas during eruption and solidification, the minerals produced in chemically similar magmas are not to be expected to be always alike, and the variations in composition are in this way understood.

Having considered the possible chemical reactions that may give rise to mineral compounds in rock magmas, the next step in the treatment of the subject is a discussion of the process and results of separation of various compounds or substances from magma solutions upon change of physical conditions attending the eruption of magmas. These may separate as gases, liquids or solids, chiefly as solids. But gases escape in large volumes upon the eruption of lavas, mostly as water vapor. There are other kinds in smaller, though often in considerable, amounts. The effects of this loss of gases are in the chemical composition of the rock magma, in the concentration of the remaining substances, and in the viscosity of the magma, which may increase notably upon loss of gas.

Liquids, probably, do not separate as such from molten magmas to any consider-

able extent. Apparently liquid silicates are miscible in one another in all proportions, though suggestions that they may not be have been advanced by some petrologists. It is known that liquid sulphides and silicates are not miscible in all proportions at all temperatures. And where sulphides exist in large amounts, separation in the liquid phase may take place with falling temperature.

Separation of solids from solution depends upon the attainment of a sufficient molecular concentration of substances to saturate the solution. Saturation may be brought about in several ways: by chemical reaction within the solution consequent upon a change of chemical equilibrium; by change of temperature, usually by lowering temperature; by change of pressure, either acting in an opposite manner from temperature or by affecting the gas content.

Solids may separate when the point of saturation for them has been reached, or the liquid may become superheated, and separation be delayed. In this condition separation is often induced by the insertion of a solid of like composition, or of an isomorphous compound, or by agitating. Such a condition of a liquid has been called *metastable*, and in this condition, as shown by Miers in laboratory observations on liquids of organic compounds, crystallization of the separating substance takes place, at relatively few points, and proceeds gradually, according to degree of concentration and other factors, until comparatively large individuals are formed. If supersaturation proceeds without separation of solid phase a point will be reached when separation will take place spontaneously at many points in the liquid and continue rapidly. This is the *labile* condition of the liquid. When this condition is reached by a cooling liquid crystallization often takes place suddenly as a shower of minute individuals, as observed by Miers. The bearing of these facts on the textures of igneous rocks is apparent, and a knowledge of the laws relating to the separation of solids from liquids; the order in which those of different substances may follow one another in a mixed solution; the separation of isomorphous compounds; and the shapes that may be assumed by the resulting crystals of various minerals lead to an understanding of the texture of igneous rocks.

A supersaturated condition is more readily obtained in more viscous liquids, which are more apt to solidify without crystallization, as glasses, than more fluid liquids. The most familiar illustrations of this law among igneous rocks are the persilicic (rhyolitic) lavas, which often form glasses (obsidians). The question has been raised by Crosby, and others, whether an earthquake happening when a magma was in a sufficiently supersaturated, metastable, condition might not induce crystallization of some of the constituent compounds.

Crystallization may begin with different degrees of supersaturation of the liquid, and would proceed at different rates according to the degree of supersaturation, being more rapid the greater the concentration. It would also be more rapid the greater the molecular diffusivity, that is, the lower the viscosity of the liquid, and the greater the rate of cooling, so long as this does not increase viscosity too rapidly. Gradual or slow crystallization at comparatively few centers would yield relatively few, large, crystals; whereas sudden, rapid crystallization from many centers would produce many small ones.

High fluidity in solutions would permit easy diffusion of separating molecules toward crystallizing centers, favoring the growth of relatively large individuals. High viscosity would retard diffusion and

favor the growth of many small crystals. This is well illustrated by the laboratory experience of Day with the crystallization of various lime-soda-feldspars. Thus it was found that 100 grams of liquid anorthite crystallized completely in ten minutes to fair-sized crystals, and it required quick chilling to prevent its crystallization and to produce glass. A mixture of equal parts of anorthite and albite (Ab_1An_1) required a gradual cooling extending over several days to effect complete crystallization, whereas liquid albite could not be induced to crystallize through days of cooling in an open crucible. Comparing the size of the crystals of anorthite produced in 10 minutes with those of oligoclase-andesine (Ab_3An_1) which were produced by gradual cooling through two days, the former were from 3 to 5 mm. thick, the latter about 0.005 mm. thick. That is, the more liquid anorthite produced crystals one thousand times as thick in about one three-hundredth the time, a ratio of 300,000 : 1.

The rate of separation of solid from liquid also depends on the solubility and the amount of any substance in solution. The greater each of these factors the more rapid the rate of crystallization and the larger the crystals, other things being constant in compared cases. This law has been expressed definitely by von Pickardt as follows: "The velocity of crystallization (separation in solid phase) is diminished by the addition of foreign substances to the liquid phase of a substance, the diminution of the velocity being the same for equimolecular quantities of all substances."

The order of succession in the separation of different kinds of minerals from molten magma is a subject upon which there has been some difference of opinion among petrologists. It has been clearly demonstrated that the order is not an invariable one. The laws relating to the order of separation of solids from mixed solutions have been definitely determined for solutions of various compounds in one another and the general principles are applicable to the study of igneous rocks. The attention of petrographers has been called to these laws by Vogt.

The order of separation of several compounds in solution in one another depends on the degree of saturation of each, that with the highest degree of saturation, or that one whose saturation point is reached first upon the cooling of the solution separates first. The relation between saturation, molecular concentration and the melting point of each compound has been established in general terms for different sets of cases by Meyerhoffer, and further elaborated by Roozeboom for cases of crystals of isomorphous compounds.

In all cases where the mixed compounds do not unite chemically to form new compounds, or physically as mixed crystals, there is one minimum point of temperature for a mixture of two compounds, and more than one in more complex mixtures, at which a certain proportioned mixture remains liquid. At this temperature the two components of a binary mixture will crystallize simultaneously. This minimum temperature and particular mixture are called eutectic.

Miers has shown that when supersaturation sets in and the labile condition is taken into account, the minimum temperature of separation and corresponding proportions of the mixture do not coincide with those already described as eutectic. These he has called hypertectic.

A study of these principles shows that there can be no invariable order of separation, or crystallization, of the constituent compounds in a series of mixed solutions composed of like compounds. And that simultaneous crystallization of pairs, or of

more than two kinds of separating compounds, may take place in solutions of whatever composition. Eutectic mixtures may consist of more than two components. Moreover, the supersaturation of a solution by one component may affect the proportion between two or more components at the moment of synchronous crystallization. Synchronously crystallized mixtures of certain kinds of components, therefore, are not necessarily similarly proportioned. The bearing of these principles on the crystallization and texture of igneous rocks is manifold. A few illustrations will suffice. Quartz may be the first mineral to separate from a molten magma when the solution is so rich in silica that upon cooling it becomes saturated with silica before being saturated with feldspar or some ferromagnesian compound, or even iron oxide. Quartz may be the last mineral to separate from magmas so rich in feldspar or ferromagnesian compounds as to become saturated by these upon cooling before being saturated with quartz.

Either labradorite or augite may separate first from a mixture of the two, according to which saturates the solution first upon cooling, and this depends on their relative amounts in the solution, and their order of crystallization is further modified by the possibility of one or the other producing supersaturation in the liquid. This will account for the differences of texture often noted in certain gabbros, or basalts, of almost the same composition.

Eutectic mixtures, or those whose components crystallize simultaneously, often yield aggregates of intergrown crystals, the most familiar examples of which are found in graphic granite, and certain alloys. But Miers has called attention to the fact that the simultaneous crystallization of two compounds in eutectic proportions does not invariably produce intergrown individual crystals, or graphic intergrowths. It may result in granular aggregations of concerted, adjacent anhedrons not intergrown, which corresponds to observations on the textures of igneous rocks, for many rocks of like composition in some instances exhibit graphic texture, in others evenly granular texture. Accepting graphic intergrowth as evidence of synchronous crystallization, and of the existence of eutectic proportions in some cases between the several mineral compounds at the moment of crystallization, it is to be noted that such intergrowths have been developed in igneous rocks between quartz and potash-feldspar, quartz and sodic feldspars, quartz and biotite, feldspar and pyroxene, feldspar and hornblende, feldspar and nephelite, pyroxene and iron oxide (probably magnetite) and between other pairs of minerals.

The separatiou of solids, that is, the crystallization of minerals from rock magmas, must be an extremely intricate process, because of the complex character of the solution, the variable and irregular changes in temperature and pressure consequent on the movements of eruption, the variations iu composition due to changes in gaseous components, and the possibility of chemical reaction among the components with changes of chemical equilibria, as well as the probable supersaturation of the magma by different components to various degrees. This complexity will doubtless prevent exact statements of the relations between composition and texture, but approximations may be made to the proper explanation of some of the most common and characteristic textures, which will render them more intelligible to the student.

The crystallization of a substance from solution involves molecular diffusion, and molecular orientation, and these are functions of molecular attraction, composition of the molecular compound, viscosity of the

liquid, composition of the liquid, temperature, pressure and time, or rate of changing conditions. The combination of these factors in the case of any cooling rock magma results in rock possessing a certain degree of crystallinity, which may range from a state of complete crystallinity, to the reverse, or complete glassiness. When more or less crystalline, the size of the crystals becomes a feature of consequence. The granularity, or the size of crystals in rocks, has been given a prominent rôle in most descriptions, and classifications of rocks. The shapes of individual crystals clearly give distinctive character to the pattern, or fabric, of rocks, and shape is largely a function of crystal structure and physical habit of specific minerals. The recognition of these relationships and their systematic treatment in the description and discussion of igneous rocks will lift the subject out of a maze of confusing, complex detail, usually treated in an uncoordinated and meaningless manner.

Application of principles of molecular diffusion; of laws relating to solution pressure, or osmotic pressure; of conditions controlling crystallization, or the separation of solids from solutions; of conditions affecting the physical character of liquids, or rock magmas; to the observed variability in the composition of igneous rocks, and to the known relation between their composition, order of eruption, and mode of occurrence, leads to conceptions of their origin from other magmas, by processes called by the general designation of *differentiation.*

With such an understanding of the causes of heterogeneity in rock solutions the great variability in the composition of igneous rocks as shown by chemical analyses, and by a quantitative study of their mineral composition, appears as the natural, as well as the logical, result of their mode of formation.

Mineralogical and constitutional facies of igneous rocks are readily comprehended; and the absence of fixed types of magmas, or of frequently recurring bodies of igneous rocks with definite or invariable composition, becomes "natural," and is the thing to be expected. Variations in texture within one rock mass, and among rock bodies having various modes of occurrence, are readily understood as the results of variability in the conditions attending volcanic eruption.

As to the possible character of volcanic eruption, some conception of it may be derived from a consideration of the probable condition of highly heated rock material under great pressure deep beneath the surface of the earth, as well as its probable experience in moving upward and out upon the earth's surface.

The high temperature of volcanic lavas when they reach the atmosphere, the fact that they were losing heat continually from the time of their first movement upward, the evidence that they were completely liquid at some stage in their eruption, together with the observed gradient of increase of temperature downward from the surface of the earth, all combine to show that rock magmas come from some region where the temperature is considerably above the melting point of igneous rocks. The behavior of the earth as a rigid globe, and the known effect of pressure in counteracting that of heat, together with its estimated high gradient of increase downward within the earth, force the conclusion that at sufficient depth magma, though hot enough to be liquid, behaves as a solid. Such conditions of heat and pressure can not vary abruptly from place to place, but must be nearly the same for large volumes of material; and differences of temperature and pressure must obtain very gradually, chiefly in vertical directions. Magma in

such a position must be in a virtually static condition until it experiences change of pressure or stress. Whatever its composition, it must remain unchanged.

A change of stress may come about by movement in the overlying portion of the earth. Orogenic movement, readjustment of the upper rigid, rock mass, from whatever causes, when profound, must affect the stresses in still deeper parts. The known crustal movements behave as bendings of the upper rock mass, which in places at the earth's surface appear to result in tensile stresses; in places, in compressional stresses. Beneath each of these the effective stresses must be of the opposite kind; under the tensile, compressive stresses, and under the upper compressive ones, tensile stresses. Tensile stresses should occur at some distance below ocean beds, and more especially along the borders of oceans and continents. Compressive stresses should occur, in general, beneath continental masses.

Tensile stress, as at the bottom of a synclinal arch, operating in a rigid mass must communicate itself downward as far as the mass behaves rigidly. When the hot mass is potentially fluid, that is, is kept solid by pressure, change of stress must be followed by change of position of the mass. A tendency to pull apart or stretch in the potentially fluid mass must be followed by a yielding of the mass. At a point sufficiently cool for the mass to act as a solid a tendency to fracture and to open a fissure would be followed by a movement of the slightly more heated mass beneath to occupy the space between the fractured solid; these differences of temperature and of rigidity are to be understood in a mathematical sense as differential, there being a gradation of physical conditions between adjacent parts of the mass. There will be no open space, or fissure, in the ordinary sense. But it must be understood that at whatever depth the mass may be considered solid, there it may fracture, part and become the walls of a layer or body of intruded liquid, provided the liquid have nearly the same density as the solid mass.

The statement made by Van Hise and Hoskins that open cracks, or fissures, can not exist at greater depths than about 10,000 meters was made on the assumption that the filling is water; the difference in weight of the rock and the hydrostatic pressure of the corresponding column of water being compared with the crushing strength of the solid rock. When the liquid is heavier than water the same method of calculation allows fissures filled with such liquid to exist at greater depths; and if the weight of the column of liquid equals that of the wall rock, the two will remain in equilibrium at any depth. Consequently at any depth in the earth mass where a tendency to part may exist, hotter and potentially more fluid material beneath may move up and permit the parting of the slightly more rigid mass to take place. This would appear to be the initial step in the eruption of rock magma.

As the mass shifts its position upward the pressure upon it decreases, resulting in some expansion of the volume, some decrease in density, some increase in mobility. And the rising mass is hotter than the masses between which it is rising, unless movement is at the same rate as the diffusion of heat. In proportion as the tensile stress is strong the upward movement will be pronounced, and may result in a flow of very dense, hot, viscous magma toward the surface of the earth. The greater the vertical distance traversed and the more rapid the rate of movement, the greater the difference in temperature between the magma and the enclosing mass.

That the eruption of rock magma is con-

sequent upon the adjustment of accumulated stresses within the overlying rocks is indicated by the sequence of fractures and lava flows in the uppermost parts of the earth, and the opening of eras of great volcanic activity after profound orogenic movements have disturbed the comparatively quiet action of forces that have been gradually shifting the stresses within the outer portion of the earth. The magnitude of the adjusting action is evinced by the extent of territory simultaneously affected. As, for example, the initiation of volcanic action on a gigantic scale throughout western America at the end of Cretaceous time, after an enormous period of nearly uniform conditions of comparative quiet.

The eruptive impulse, or energy, causing the upward flow of magma, must originate in the expansion of the magma upon relief of pressure consequent upon the adjustment of stresses in the overlying mass, and from expansive energy of dissolved gases. That the eruptive force is of nearly the same order of magnitude as the stresses within the earth's crust is shown by the relatively small amount of material erupted upon the surface of the earth compared with the bulk of the whole; by the common intrusion of magma along fracture planes and along those of structural weakness, rather than at random through rock masses; and most conspicuously, by the evidence of equilibrium with the atmosphere maintained by lava in volcanic craters. Open vents are known to exist for centuries without great extrusion of rock magma, as at Stromboli. The stresses which produce condensation of volume in proportion to depth and the results of expansion of volume are, therefore, somewhat evenly balanced.

The effect of expanding gases is shown in the explosive character of many eruptions, and the periodic character of all eruptions from open vents (volcanoes). It must increase the volume of all magmas as pressure is relieved. Its effectiveness must increase in proportion to the amount of gas in the magma, which may result from diffusion of gas from greater depths of magma, and also from accession from adjacent rocks under favorable conditions.

Spasmodic eruption may follow sudden yielding of overlying rocks to long continued stresses, as in the case of massive, or fissure, eruptions when there may have been no considerable explosive action of gas; or it may result from an accumulation of gas pressure sufficient to rupture overlying rock masses. Eruption is then accompanied by abundant evidence of explosion. Both causes undoubtedly operate together in most cases.

In so far as magmatic eruption is a result of volumetric expansion of the magma, due to relief of pressure, the shrinkage of volume due to cooling will retard eruption, or eventually stop it. Crystallization will operate in the same direction. In proportion as eruption is due to expansion of dissolved gas, the escape of gas from magma, or the reduction of supply, will lessen the force of eruption, or eventually put an end to it. The supply of gas from great depths may be reduced by the gradual diffusion of whatever is in a position to be appreciably diffused; or the supply from rocks adjacent to intruded magma may be cut off by the closing of pores in these rocks through metamorphism; porous rocks becoming dense and almost impervious to gases. In these ways eruptive action initiated by crustal readjustment after continuing for variable periods may come to an end. Readjustment of stresses may recur from time to time in any region, either at such widely remote periods that the volcanic activities associated with each readjustment constitute distinct and separate periods of action; or at such frequent intervals that the results of several profound movements are combined to form a

prolonged period of complex volcanic eruptions.

Independence of action at neighboring volcanoes, either as to period of eruption, volume of magma erupted, explosive or quiet character of action, or relative height of lava column in conduit of volcanoes, follows from local variation in the factors entering into the process of magma eruption, such as, the volume of magma involved in each conduit extending to profound depths, the shape of the conduit, the temperature of the magma; the rate of cooling; the amount of gas diffused in any given time; the character of the surrounding rocks; and the stability of the surrounding rock masses as a complex whole. The chemical composition of the magma is also a factor involved in the activity of a particular volcano. But the composition of the magma is also a feature by which volcanoes may show independence. Differences in the composition of rocks in neighboring volcanoes is to be sought in variation in the differentiation of magmas during the course of eruption from deep-seated to surficial positions.

Among the results of such differentiation may be mentioned the production of complementary rocks, which may occur in rock bodies of various forms. A special case of local differentiation, usually associated immediately with crystallization and solidification of parts of a magma, is the production of contemporaneous veins and pegmatites. When complementary rock magmas are erupted so close to one another in space and time that they come in conjunction while still highly heated, they may diffuse into one another, or blende to such an extent as to yield hybrid rocks, or mixed dikes, sheets, etc., as observed by Harker on the Isle of Skye.

The eruption of rock magmas through solid rocks and their solidification in various positions within or upon other rocks condition the modes of occurrence of igneous rocks, as those of lava streams, dikes, sheets, laccoliths, etc. And the parting or cracking of the solid rock, upon cooling, or its arrangement after fragmentation in various ways leads to distinctive structures, such as columnar, spheroidal or brecciated.

Having acquired a knowledge of the general principles applicable to all igneous rocks, it is in order to consider more specifically those occurring in all known parts of the world: first, systematically, according to some comprehensive scheme of arrangement, or classification, and then according to the groups, or associations, in which they occur in various regions, that is, according to petrographical provinces, or co-magmatic regions.

In order to describe many rocks a nomenclature is necessary, and the confusion existing in that in present use is best understood by considering the history of the growth of petrography, and the changes that have gone on in the definition and use of the oldest and commonest rock names, and descriptive terms. With this review should be associated a sketch of the development of rock classification, which has been furnished to the student in an interesting form by Cross.

A successful treatment of the subject of igneous rocks along the lines indicated would go far toward the removal of petrology from a state of distracting empiricism, and the placing of it on a more rational foundation.

JOSEPH P. IDDINGS

WASHINGTON, D. C.

CONDUCT OF SCIENTIFIC WORK UNDER THE UNITED STATES GOVERNMENT[1]

To the Senate and House of Representatives:

In compliance with the provisions of section 8 of the act of Congress making appropriations

[1] Message from the President of the United States, transmitting a report of the National Academy of Sciences relating to the conduct of the scientific work under the United States government.

for sundry civil expenses of the government for the fiscal year ending June 30, 1909, approved May 27, 1908, I transmit herewith for the consideration of the Congress the report of the National Academy of Sciences relating to the conduct of the scientific work under the United States government.

THEODORE ROOSEVELT

THE WHITE HOUSE,
January 18, 1909

NATIONAL ACADEMY OF SCIENCES,
OFFICE OF THE PRESIDENT,
Baltimore, January 16, 1909

Sir: The sundry civil act approved May 27, 1908, requests the National Academy of Sciences to consider certain questions relating to the conduct of the scientific work under the United States government, and to report the result of its investigations to Congress.

Immediately after the passage of the act a committee, consisting of five eminent men of science, none of whom held employment under the United States government, was appointed to make the necessary investigation. The members of that committee are:

R. S. Woodward, president of the Carnegie Institution of Washington, chairman.

W. W. Campbell, director of the Lick Observatory, Mount Hamilton, Cal.

Edward L. Nichols, professor of physics, Cornell University.

Arthur A. Noyes, acting president of the Massachusetts Institute of Technology.

Charles R. Van Hise, president of the University of Wisconsin.

Under date of January 9, 1909, this committee submitted its report to the council of the academy.

I have the honor to transmit herewith this report to Congress.

I am, sir, very respectfully,

IRA REMSEN,
President National Academy of Sciences

THE SPEAKER OF THE HOUSE
OF REPRESENTATIVES

REPORT OF COMMITTEE ON CONDUCT OF SCIENTIFIC WORK UNDER THE UNITED STATES GOVERNMENT

To the Council of the National Academy of Sciences:

During the first session of the Sixtieth Congress of the United States there was incorporated in the act making appropriations for sundry civil expenses of the government for the fiscal year ending June 30, 1909, the following section, namely:

SEC. 8. The National Academy of Sciences is required, at their next meeting, to take into consideration the methods and expenses of conducting all surveys of a scientific character and all chemical, testing and experimental laboratories and to report to Congress as soon thereafter as may be practicable a plan for consolidating such surveys, chemical, testing, and experimental laboratories so as to effectually prevent duplication of work and reduce expenditures without detriment to the public service.

It is the judgment of Congress that any person who holds employment under the United States, or who is employed by and receives a regular salary from any scientific bureau or institution that is required to report to Congress, should refrain from participation in the deliberations of said National Academy of Sciences on this subject and from voting on or joining in any recommendation hereunder.

In compliance with the terms of this legislation, the president of the National Academy of Sciences appointed the undersigned committee to consider the questions specified in said legislation, with a view of securing a report on or before the next annual meeting of the academy. This committee now has the honor to submit a report.

It should be explained, first, that in compliance with a request addressed by the president of the academy to the President of the United States, all of the executive departments of the government were directed to assist the representatives of the National Academy of Sciences in securing such information as might be necessary in preparing this report. The communication from the President of the United States announcing that such direction had been issued bears the date June 29, 1908. In conformity therewith numerous communications have been received by your committee from heads of departments and from bureaus and divisions of the government engaged in the kinds of work specified in the legislative act cited above.

In the second place, it should be stated that this committee has had access to the unpub-

lished preliminary report of a committee appointed by the President of the United States March 13, 1903, to consider many of the same questions here reported upon and others closely allied thereto. The chairman of the latter committee has also placed at our disposal a large mass of data collected by that committee.

In the third place, it should be stated that the members of your committee have been chosen in strict conformity with the requirements of the second paragraph of the legislative act quoted above.

A comprehensive interpretation of the functions of your committee shows that the field work for consideration is very large, and that it presents many difficulties requiring the most careful study before any final recommendations for legislative or executive action may be safely made. Nearly every department of the government is involved to a greater or less extent, while some departments, like the Department of Agriculture and that of Commerce and Labor, are carrying on scientific work in a great variety of ways. Thus, to illustrate the extent and variety of this work, it may be stated that surveys are now being carried on by seven different organizations under five different departments of the government; similarly, tests of apparatus, materials, foods, etc., are being made by the Bureau of Standards, by the technologic branch of the Geological Survey, by the Department of Agriculture, and to a minor degree by many other departments and bureaus of the government. Similarly, chemical work is carried on in many branches of the Department of Agriculture, by the Bureau of Standards, by the Geological Survey, by the Public Health and Marine-Hospital Service, and to a less extent by other branches of the public service.

It should be borne in mind also, in considering the present status of these organizations carrying on scientific work, that many of them have been so long established as to become integral parts of the departments to which they are assigned. Hence, any considerations looking to a consolidation or to a redistribution in the departments of these organizations should take into account their origin and historical development as well as their present status. The experience gained through a long series of years by these organizations should indicate what special merits they possess as well as the defects of organization and efficiency they may now present.

In view, therefore, of the importance of the scientific work now carried on by the government, and in view of the certain prospect that it will increase rather than decrease in the future, your committee is disposed to look at the problems presented by this work with a desire rather to furnish constructive criticism and advice than to recommend any immediate and radical changes based on destructive criticism, however well founded the latter may be in some cases. In other words, it appears more important to your committee to provide for enlightened and efficient conduct of governmental scientific work in the future than to be influenced to any considerable degree by the imperfections of organization and the inefficiencies in conduct of that work in the past.

From a general survey of the field of work under consideration three facts appear to be clearly established, namely:

First. That the amount of actual duplication of work now carried on by the government bureaus is relatively unimportant: but that the duplication of organizations and of plants for the conduct of such work is so considerable as to need careful attention from Congress in the future.

Second. That while the consolidation of some branches of work now carried on in several organizations is probably advisable, specific recommendations in reference to such consolidation can be made wisely only after a careful consideration of all the facts by the board hereinafter suggested or by some similarly competent body.

Third. That there has never been hitherto and there is not at present anything like a rational correlation of allied branches of scientific work carried on by the government.

This last fact appears to your committee by far the most important one presented for consideration. The lack of any well-defined plan for the development of such work, its distribution in various departments, and the lack of any systematic scheme of interrelations of the

bureaus carrying on this work have led inevitably and properly to the questions submitted by Congress to the academy.

It is plainly desirable, therefore, that Congress should make immediate provision to guard against a continuance of the evils which arise from a lack of any definite plan for, and from the absence of any adequate correlation of, the scientific work of the government.

It appears to your committee that the best way to deal with the condition now confronting the government is to secure the appointment by Congress of a permanent board which shall meet at stated intervals in each year for the consideration of all questions of the inauguration, the continuance, and the interrelations of the various branches of governmental scientific work. We would suggest that such a board should consist of the heads of bureaus carrying on scientific work, of two delegates from each of the Houses of Congress, and of five to seven eminent men of science not connected with the government service.

By means of a few meetings per year, with authorization to secure the requisite information from the heads of departments and bureaus concerned, all of the complicated questions which now are at best only ill considered could be carefully determined with great advantage in point of economy and efficiency to the public service and with little or no additional expense thereto.

Such a board could take under consideration the prevailing lack of system and lack of correlation in the work in question and gradually remove these defects from existing bureaus and divisions of the public service. All questions of the assignment, of the conduct, of advisable consolidation, and of the economies of such work could be fully discussed and determined in the best interests of the government by such a board. If the heads of bureaus and divisions were required to submit their projects and estimates for work to this board before transmission to the heads of departments and to Congress, all questions of the duplication of work, of the duplication of organizations, of the duplication of laboratories or equipments, and of the most economical assignment could be readily determined without interference in the details of management of the organizations concerned.

One of the most important functions of such a board should be that of the nomination or selection of men competent to take charge of new projects or to fill vacancies which may arise in the more important positions of the scientific work in question. It would thus be generally possible to prevent the assignment of an incompetent man to the charge of a highly technical or specialized branch of the public service. It would thus be possible also to secure men of the highest professional attainments and to prevent the calamity which has not infrequently occurred in the past of assigning important scientific work to unprofessional or incompetent men. It would thus be possible likewise to take advantage of the competition between different branches of the public service in the laudable desire of those branches to prove their efficiency by the accomplishment of the required work of the government in the best and most economical ways.

Very respectfully submitted.

R. S. Woodward,
Chairman,
W. W. Campbell,
Edward L. Nichols,
Arthur A. Noyes,
Charles R. Van Hise

Washington, D. C.,
January 9, 1909

RECENT WORK OF THE MOUNT WILSON SOLAR OBSERVATORY

Monochromatic photographs of the sun have been made daily on Mount Wilson since October, 1905, with the Snow telescope and five-foot spectroheliograph. The weather has been very favorable, permitting calcium, hydrogen and frequently iron images to be taken on 303 days in 1908, and on 113 consecutive days during the summer of 1907. Prior to March, 1908, the hydrogen photographs were made with the light of the violet line $H\delta$. Since that time, with the aid of plates sensitized by Wallace's formula, excellent results have been obtained with the red hydrogen line $H\alpha$. These record the phenomena of a region in the solar atmosphere higher than that previously

explored, and reveal the existence of extensive vortices or cyclonic storms associated with sun-spots. In general, the direction of rotation of the vortices is counter-clockwise in the northern hemisphere and clockwise in the southern, as in the case of terrestrial cyclones; but a few interesting exceptions, in which the direction of rotation was reversed, have been found. There can now be little doubt that what we see in the telescope as a sun-spot is the mass of vapor, cooled somewhat below the temperature of the photosphere, which lies at the center of an invisible vortex (*Astrophysical Journal*, Vol. XXVIII., pp. 100–16).

The discovery of these vortices suggested that the rapid revolution of electrically charged particles, emitted from carbon and other vapors at the high temperature of the sun, should produce a magnetic field in sun-spots. Tests made with the 30-foot spectrograph of the tower telescope show all the characteristic phenomena of the Zeeman effect in the spot spectrum, and leave no doubt as to the existence of a magnetic field. The strength of the field has been found to range from about 2,800 to about 4,500 gausses in different spots. Vortices rotating in opposite directions show opposite polarities, the changes in the spectrum and in the polarization phenomena being precisely similar to those of a luminous source in a magnetic field when the current through the magnet is reversed. The results indicate that the magnetic field is produced by the revolution of negative corpuscles in the vortices (see *Astrophysical Journal*, Vol. XXVIII., pp. 315–343). There is some evidence that the plane of polarization of light passing through the spot vapors is rotated through different angles in different parts of the umbra, but more observations of this phenomenon are needed. For this and other purposes a tower telescope 160 feet high, giving a solar image 16 inches in diameter, and a spectrograph 75 feet long, mounted in a well below the tower, should prove of the greatest service. These instruments are now being designed, and will soon be constructed in our Passadena shop.[1]

The above results are of some general interest, since they conclusively demonstrate for the first time the operation of electric phenomena in the sun. So far as the cause and nature of sun-spots are concerned, they seem to favor Emden's theory. An attempt is now being made to determine whether the sun as a whole is a magnet. The tests already completed indicate that extremely sensitive methods will be required to settle the question, and these will soon be applied.

The 60-inch reflecting telescope, which has been under construction in our instrument and optical shops during the last four years, is now in operation on Mount Wilson. Visual and photographic tests show this instrument to be of the highest optical and mechanical perfection, and reflect great credit upon Professor Ritchey, its designer, and those who have been associated with him in the extensive work of construction and erection. Photographs of nebulæ made by Professor Ritchey, and a series of photographs of the great nebula in Orion, made through a red screen by the writer, are of exquisite sharpness and perfection of detail. The star images are extremely small, and the wealth of faint stars shown leaves no doubt that in light-grasping power, as well as in optical resolution, the telescope will meet our highest expectations. One of the most gratifying results of these tests is the proof they afford of the excellence of the night conditions on Mount Wilson. For the last four consecutive nights (January 16, 17, 18, 19) the definition with the full aperture of 60 inches has been essentially perfect from a photographic standpoint. This is in the midst of the rainy season, when the atmosphere is far less steady than during the unbroken succession of clear days and nights of summer. A telescope of 100 inches aperture, or even larger, could certainly be used here to great advantage on nights such as we have already tested. Fortunately, Mr. John D. Hooker, of Los Angeles, has agreed to meet the expense

[1] This telescope, of small aperture (12 inches) and great focal length (150 feet), is designed exclusively for work on the sun, where a large image is required. The 60-inch and 100-inch reflecting telescopes, of great aperture and smaller focal length, are not suitable for solar observations, but will be used for the study of stars and nebulæ.

of constructing a large mirror for this observatory. A disk of glass 100 inches in diameter and 13 inches thick, weighing 4½ tons, has recently been received at our Pasadena shop from the French Plate Glass Works at St. Gobain, France. Much time was consumed in filling our order, and it was hoped that the disk would prove suitable. This does not turn out to be the case, however, and another trial must be made. The observatory will experience no financial loss, as the disk had not been accepted. The loss in time will not be very serious, because of the great opportunities for research in unexplored fields afforded by the 60-inch reflector. I have no doubt that the difficulties of making a homogeneous disk of these great dimensions will soon be successfully overcome, and that the Hooker telescope will be ready in time to extend the work of the 60-inch reflector into territory which even this powerful instrument can not enter.

GEORGE E. HALE

BROOKS MEMORIAL

IN the Donovan room of McCoy Hall, Johns Hopkins University, the end of the old and beginning of the new year saw a memorable reunion of men who had worked in contact with Professor W. K. Brooks. Under the guidance of the chairman, Professor S. F. Clarke, many paid tribute to Brooks, the inspiring teacher, whose life at Williams and at Cambridge was vividly sketched by Professor Edward A. Birge, and whose career at the Johns Hopkins furnished the material for many pleasant recollections and expressions of esteem and of love by Professors E. B. Wilson, H. W. Conn, H. H. Donaldson, F. H. Herrick, M. M. Metcalf and others who were Brooks's pupils in later years.

Upon motion of Professor Harrison a committee was appointed to prepare a memorial volume in honor of their master.

Professor E. L. Mark and thirty-two other zoologists of Harvard, in attendance upon the scientific meetings in Baltimore, wrote to express their "sentiments of highest appreciation for the character of the work of William Keith Brooks."

It was hoped that the incidents of Professor Brooks's life at Penikese could be made vivid by one who was there with Brooks, but a telegram from President David Starr Jordan stated his regret that he could not be present to honor the memory of "the wisest of American naturalists." Others were also unable to come to Baltimore. The names of the sixty men actually present follows below:

Edward A. Birge, fellow student at Williams College, professor of zoology, University of Wisconsin.

Samuel Fessenden Clarke, Ph.D., 1874, professor of natural history, Williams College.

Edmund Beecher Wilson, Ph.D., 1881, professor of zoology, Columbia University.

Albert H. Tuttle, professor of biology, University of Virginia.

Basil Sollers, student, 1878–9, teacher in public schools, Baltimore.

William Henry Howell, Ph.D., 1884, professor of physiology, Johns Hopkins University.

Herbert William Conn, Ph.D., 1884, professor of biology, Wesleyan University.

Henry Herbert Donaldson, Ph.D., 1885, professor of neurology, University of Pennsylvania.

Frederick Schiller Lee, Ph.D., 1885, professor of physiology, Columbia University.

James Playfair McMurrich, Ph.D., 1885, professor of anatomy, University of Toronto.

Albro David Morrill, Beaufort Laboratory, 1885, professor of biology, Hamilton College.

George Theophilus Kemp, Ph.D., 1886, sometime professor of physiology, University of Illinois.

Louis J. Rettger, student, 1886–9, candidate for Ph.D., 1909, professor of physiology, Indiana State Normal School.

Charles L. Edwards, graduate student, 1886–9, professor of natural history, Trinity College.

F. L. Washburn, graduate student, 1886–7, state entomologist, Minnesota, and professor of entomology, University of Minnesota.

Edwin Linton, Beaufort, Laboratory, professor of zoology, Washington and Jefferson College.

Ethan Allen Andrews, Ph.D., 1887, professor of zoology, Johns Hopkins University.

Henry Gustav Beyer, Ph.D., 1887, medical inspector, United States Navy.

John Pendleton Campbell, Ph.D., 1888, professor of biology, University of Georgia.

Francis Hobart Herrick, Ph.D., 1888, professor of biology, Adelbert College.

Henry Van Peters Wilson, Ph.D., 1888, professor of biology, University of North Carolina.

Arthur Lincoln Lamb, A.B., 1888, science master, Country School, Baltimore.

Clifton Fremont Hodge, Ph.D., 1889, assistant professor of physiology, Clark University.

Thomas Hunt Morgan, Ph.D., 1890, professor of experimental zoology, Columbia University.

Henry Torsey Fernald, Ph.D., 1890, professor of entomology, Massachusetts Agricultural College.

Edwin Grant Conklin, Ph.D., 1891, professor of zoology, Princeton University.

Robert Payne Bigelow, Ph.D., 1892, instructor in biology and librarian, Massachusetts Institute of Technology.

George Wilton Field, Ph.D., 1892, zoologist, Massachusetts Board of Fisheries.

Theodore Hough, Ph.D., 1893, professor of physiology, University of Virginia.

Maynard Mayo Metcalf, Ph.D., 1893, professor of zoology, Oberlin College.

Herbert Spencer Jennings, professor of experimental zoology, Johns Hopkins University.

Ross Granville Harrison, Ph.D., 1894, professor of comparative anatomy, Yale University.

Reid Hunt, Ph.D., 1896, pharmacologist, Bureau of Health, Washington, D. C.

Henry McElderry Knower, Ph.D., 1896, associate in anatomy, Johns Hopkins University.

George Lefevre, Ph.D., 1896, professor of zoology, University of Missouri.

Hubert Lyman Clark, Ph.D., 1897, assistant in invertebrate zoology, Harvard University.

Charles Peter Sigerfoos, Ph.D., 1897, professor of zoology, University of Minnesota.

Duncan Starr Johnson, Ph.D., 1897, professor of botany, Johns Hopkins University.

Gilman Arthur Drew, Ph.D., 1898, professor of biology, University of Maine.

Caswell Grave, Ph.D., 1899, associate professor of zoology, Johns Hopkins University.

Albert Moore Reese, Ph.D., 1900, professor of zoology, West Virginia University.

William Chambers Coker, Ph.D., 1901, associate professor of botany, University of North Carolina.

Henry Farnham Perkins, Ph.D., 1902, assistant professor of zoology, University of Vermont.

Lewis Robinson Cary, student, 1903–5, holder of fellowship, Princeton University.

Rheinart Parker Cowles, Ph.D., 1904, instructor in biology, Johns Hopkins University.

Otto Charles Glaser, Ph.D., 1904, instructor in zoology, University of Michigan.

David Hill Tennent, Ph.D., 1904, associate professor in zoology, Bryn Mawr College.

Eugene Willis Gudger, Ph.D., 1905, professor of biology and geology, North Carolina Normal and Industrial College.

John Augustine English Eyster, M.D., 1905, associate professor of physiology, University of Virginia.

Samuel Rittenhouse, Ph.D., 1905, instructor in biology, Olivet College.

Robert Irvine Coker, Ph.D., 1906, special investigator for Peruvian Government.

Bartgis McGlone, Ph.D., 1907, professor of biology, St. John's College.

Ivey Foreman Lewis, Ph.D., 1908, professor of biology, Randolph-Macon College.

William E. Kellicott, lecturer, 1908, professor of biology, Woman's College, Baltimore.

Samuel Ottmar Mast, Johnston scholar, 1907–8, associate professor of biology, Woman's College.

J. Frank Daniel, Adam T. Bruce, fellow, 1908–9, Johns Hopkins University.

William Dana Hoyt, fellow in botany, 1908–9, Johns Hopkins University.

Asa Arthur Schaeffer, fellow in zoology, 1908–9, Johns Hopkins University.

Frederick Harvey Blodgett, candidate for Ph.D., 1910, Johns Hopkins University.

William Henry Brown, candidate for Ph.D., 1910, Johns Hopkins University.

SCIENTIFIC NOTES AND NEWS

As has already been announced, Sir J. J. Thomson, F.R.S., will preside over the Winnipeg meeting of the British Association to be held from August 25 to September 1 of this year. The presidents of the sections are as follows: A (Mathematical and Physical Science), Professor E. Rutherford, F.R.S.; B (Chemistry), Professor H. E. Armstrong, F.R.S.; C (Geology), Dr. A. Smith Woodward, F.R.S.; D (Zoology), Dr. A. E. Shipley, F.R.S.; E (Geography), Sir Duncan A. Johnston, K.C.M.G.; F (Economic Science and Statistics), Professor S. J. Chapman; G (Engineering), Sir William H. White, K.C.B., F.R.S.; H (Anthropology), Professor J. L. Myres; I (Physiology), Professor E. H. Starling, F.R.S.; K (Botany), Lieut.-Colonel D. Prain, F.R.S.; L (Educational Science), Dr. H. B. Gray; and subsection, Agriculture, Major P. G. Craigie (chairman).

MR. H. B. WOODWARD, F.R.S., having reached the age of seventy-six years, has re-

tired from the assistant directorship of the Geological Survey of Great Britain. He is succeeded by Dr. H. Strahan, F.R.S.

M. LÉON L'ABBÉ, who has recently been reelected to the French senate, succeeds M. Bucquosy as president of the Paris Academy of Medicine.

MR. ARTHUR SILVA WHITE has resigned as assistant secretary of the British Association for the Advancement of Science.

PROFESSOR HILLHOUSE will retire from the chair of botany in the University of Birmingham at the end of the present session.

MR. R. JAMES WALLACE, who has for several years past been engaged in photographic research at the Yerkes Observatory, as instructor in photophysics, has resigned his position there to become director of the research laboratory of the Cramer Dry Plate Company at St. Louis. It is a promising evidence of appreciation of research that a commercial company engages the services of a scientific investigator for the improvement and further development of its products.

THE Geological Society of London will this year award its medals and funds as follows: Wollaston medal, Mr. Horace B. Woodward, F.R.S.; Murchison medal, Professor Grenville A. J. Cole; Lyell medal, Professor Percy F. Kendall; Bigsby medal, Dr. John Smith Flett; Prestwich medal, Lady Evans; Wollaston fund, Mr. Arthur J. C. Molyneux; Murchison fund, Mr. James V. Elsden; Lyell fund, Mr. R. G. Carruthers and Mr. Herbert Brantwood Muff.

DR. JOHN M. COULTER, head of the department of botany in the University of Chicago, was among those who returned to New York on the *Baltic* after the ill-fated trip of the steamer *Republic*.

WE learn from *Nature* that Professor J. Arthur Thomson, of Aberdeen University, has been invited by the lecture committee of the South African Association for the Advancement of Science to give the "South African Lectures" for 1909. The lectures are to be delivered in August and September in Johannesburg, Pretoria, Bloemfontein, Kimberley, Cape Town, Grahamstown and Durban, and at the request of the committee they will have special reference to the Darwin centenary.

MR. G. W. BURY has undertaken an expedition into southwest Arabia.

MR. DONALD MACKAY is engaged in exploration in British New Guinea. He is attempting to ascend the Purari River, with a view to making his way overland to the head waters of the Fly River.

DR. C. W. A. VEDITZ, professor of economics at George Washington University, has been selected as a special expert agent for the United States Department of Labor and Commerce to investigate the child-labor problem and conditions in the principal industrial countries of Europe. He will leave this country on February 3 and will remain abroad for about eight months.

PRESIDENT ROOSEVELT has appointed Mr. W. K. Moorehead, curator of archeology in Phillips Academy, Andover, a member of the United States Board of Indian Commissioners.

DR. FRANCIS E. FREMANTLE, medical officer of health for Hertfordshire, has been appointed to the Edward Jenner lectureship in public health at St. George's Hospital Medical School, London.

UNDER the auspices of the Pennsylvania Society of the Archeological Institute of America, a public lecture was given at the University of Pennsylvania Museum on Wednesday afternoon, January 27, on "Excavations and Repairs at Casa Grande, Arizona," by Professor J. Walter Fewkes, of the U. S. Bureau of American Ethnology.

MR. FRED G. PLUMMER, chief of geography in the National Forest Service, gave a lecture on "The American Forests" before the department of geology of Colgate University, on the evening of January 20.

AT the regular meeting of the Academy of Science of St. Louis, held on January 18, 1909, with Professor Wm. Trelease presiding, Professor W. H. Roever, of the department of mathematics of Washington University, presented a paper embodying his researches on

"An Optical Interpretation of some Problems in Statistics."

At the meeting of the Royal Microscopical Society on January 20, Lord Avebury delivered his presidential address on seeds, with special reference to British plants.

Professor Karl Pearson gave last month before the Royal Institution of Great Britain two lectures on "Albinism in Man."

Sir Thomas Wardell, known for his researches on silk fiber, died on January 3, in his seventy-eighth year.

Major Percy B. Molesworth, who had made valuable observations on Jupiter and Mars, died in Ceylon on December 26, in his forty-second year.

M. Dominique Clos, honorary professor of botany at Toulouse, has died at the age of eighty-eight years.

The House of Representatives has included in the military appropriation bill an appropriation of $500,000 for air-ships. The Russian war office has reserved for this purpose a fund of $750,000. The Aero Club of America offers a prize of $10,000 for a race from New York City to Albany as part of the Hudson-Fulton memorial celebrations to be held in the autumn.

The sum of $100,000 has been given to the medical school of the London Hospital, the income to be expended in the advancement of medical research and the promotion of higher education in medicine.

Baron Bessières has left a legacy of $16,000 to the Pasteur Institute, Paris, to be employed in scientific researches.

A Royal British Radium Institute is to be established through a gift from Sir Ernest Cassel. It is intended to investigate especially the therapeutic action of radium. In this connection it is reported that a syndicate has been formed in connection with the institute to extract radium from the pitch-blend deposits of an old copper mine recently reopened at St. Ives, Cornwall. This is said to be the only place where radium can be produced outside of Austria.

A society of radiology has been founded in Paris for the scientific study of the medical applications of radiations in general.

The important George G. Heye collection of American antiquities will soon be placed on exhibition in the Museum of the University of Pennsylvania.

Two additions to the series of North American habitat groups in the American Museum of Natural History have recently been completed. These are the Duck Hawk group, representing a scene along the Palisades of the Hudson River, and the Hackensack Meadow group, which represents the nesting habits of the birds which frequent it in August.

A medical congress is to be held in Bombay, beginning on February 22. Sir George Clarke will deliver the presidential address, and the sectional meetings will last four days.

Arrangements for the North American Conservation Conference between representatives of the United States, Canada and Mexico, at the White House, February 18, are going forward rapidly, following the cordial acceptance by Sir Wilfrid Laurier, Premier, and Earl Grey, Governor-General, of Canada, and President Diaz, of Mexico, of President Roosevelt's invitation to send delegates. The conference will discuss the situation with regard to the natural resources of the respective countries and help prepare a general plan adapted to promote the welfare of the nations concerned in accordance with President Roosevelt's suggestion. This International Conference will meet at the White House by President Roosevelt's invitation. It will not be a large gathering as was the Conference of Governors at the White House last May, or the joint Conservation Conference last December between the National Conservation Commission, the Governors and the representatives of State Conservation Commissions and Conservation Committees of national organizations. The attendance will be limited to the representatives of Canada and Mexico and representatives of the State Department of the United States Government and of other executive departments which can render particular assistance to the conferees in their deliberations,

and the National Conservation Commission. Canada has already taken active steps in preparation for the conference and recently sent to the National Conservation Commission a number of carefully prepared maps which show the present status of the public lands of the dominion as well as the distribution of the principal natural resources and the development of its transportation systems. The Canadian authorities have also gathered together and sent to the chairman of the commission a comprehensive collection of government documents bearing on the natural resources of the country. These have been carefully indexed and bound together according to subjects. They will be used at the forthcoming conference.

MR. D. C. SOWERS, in charge of the special magnetic expedition to China under the auspices of the Carnegie Institution of Washington, left Peking on January 30. He will be assisted by Professor Chester G. Fuson, for the past four years professor of history and geography at the Canton Christian College. The general route to be followed by the party will touch at the following places: Sianfu, Lanchowfu, Suchow, Turfan, Kashgar, Khotan, thence, via the Karakorum Pass, into India, where connection will be made at Dehra Dun with the magnetic survey of India. A series of magnetic observations will, therefore, be obtained in parts of China and Chinese Turkestan where no previous data existed. Dr. J. C. Beattie, director of the department of physics, South African College, Cape Town, has been granted a year's furlough in order to take charge of a magnetic survey party under the auspices of the Carnegie Institution of Washington. He left Cape Town November 25. His general route of travel will be through German Southwest Africa, thence into Rhodesia, British East Africa, German East Africa, and next through Nubia and Egypt, connecting with the magnetic survey of Egypt at Cairo. He will be assisted by Professor J. T. Morrison, in charge of the department of physics, Victoria College, Stellenbosch, South Africa, who will confine his work chiefly to points reached by steamer along the east and west coasts of Africa. There will thus be obtained during the present year magnetic data in regions of Africa hitherto almost entirely unexplored. Mr. Joseph C. Pearson, who during the past year has been engaged in making magnetic observations in various parts of Persia under the auspices of the Carnegie Institution, will be ready to undertake similar work in Asia Minor, beginning at Bagdad some time in March.

PRIZES conferred by the Paris Academy of Medicine include: the Baillarger prize (£80) to Dr. A. Rodiet, of Dun-sur-Auron, for a contribution to the study of the organization of lunatic asylums; the Barbier prize (£80) has been divided among several competitors, Dr. P. Remlinger, of Constantinople, getting £32 for a series of researches on rabies, Dr. L. Malloizel, of Paris, £24 for anatomo-clinical researches on pleuro-cortical reactions, and Drs. Louis Wickham and Degrais, of Paris, a like amount for their work on the treatment of angiomas of radium. To Professor Calmette, director of the Pasteur Institute at Lille, and MM. Boullanger and E. Rolants, heads of laboratories, F. Constant and L. Massol, demonstrators in the same institute, and Professor Buisine, of the Lille Faculty of Science, has been awarded the Orfila prize (£160) for researches on the purification of water that has been used in towns and of the residual water of factories. Dr. Marfan has won the Roger prize (£100) for his treatise on suckling and the feeding of infants. The Saintour prize (£176) has been awarded to Dr. Emile Sergent, of Paris, for his work on syphilis and tuberculosis; the Campbell-Dupierris prize (£92) to Dr. Morris Nicloux, *Professeur agrégé* of the Paris Faculty, for his work on general anesthetics from the chemico-physiological point of view. The Ernest Godard prize (£40) has been awarded to Dr. F. W. Pavy, of London, for his work on carbohydrates and their transformation—a physiologico-pathological study with considerations on diabetes and its treatment.

THE New York State Bar Association at the closing session of its thirty-second annual meeting at Buffalo on January 29, went on

record in favor of a bill designed to correct the evils of expert medical testimony in the courts. The draft of the bill provides, among other things, that "in criminal cases for homicide where the issues involve expert knowledge or opinion the court shall appoint one or more suitable disinterested persons, not exceeding three, to investigate such issues and testify at the trial; and the compensation of such person or persons shall be fixed by the court and paid by the county where indictment was found, and the fact that such witness or witnesses have been so appointed shall be made known to the jury. This provision shall not preclude either prosecution or defense from using other expert witnesses at the trial."

UNIVERSITY AND EDUCATIONAL NEWS

A BILL has been introduced in the Wisconsin legislature which proposes to increase the building fund of the University of Wisconsin from \$200,000 to \$300,000 annually, and to lengthen the period of this appropriation from five to seven years.

A NEW industrial fellowship has been presented to the University of Kansas by the Holophane Glass Co. It yields \$1,500 a year for two years, together with ten per cent. of the profits that may arise from any discoveries made by the student who pursues the special study. The fellowship is open to students of any university, but the work will be done in the laboratories of the University of Kansas.

BRYN MAWR COLLEGE has established ten graduate scholarships, five open to English, Irish or Scotch and five to German women students, who have attained a standard equivalent to that of the bachelor's degree. The scholarship covers the fees for board, residence and tuition at Bryn Mawr College for one academic year and as these fees for graduate students amount to \$405 this is equivalent to a scholarship of £81 or of 1,620 Marks.

MR. CHINUBHAI MADHOWLAL has given four lakhs of rupees (about \$125,000) to be applied by the Bombay Government towards the development of science teaching in Ahmedabad, in connection, if possible, with the proposed Curline Institute in Bombay.

THE University of Liverpool has received an offer from Mr. Alexander Elder, to contribute \$50,000 for the establishment of a chair of naval architecture.

ON recommendation of the faculty of the medical department of Western Reserve University, the trustees have voted that beginning with the academic year 1910–11 the requirement for unconditional entrance to the medical department shall be graduation from an approved college or scientific school granting the bachelor's degree (or equivalent) following the completion of a course of at least three collegiate years and including inorganic chemistry, physics, biology and Latin. Conditional entrance will be granted upon the completion of the work of the junior year in the course of an approved college or scientific school enforcing a four-year course (or equivalent degree) including the subject requirements enumerated above, conditioned upon the student obtaining a baccalaureate degree before he enters the third year in the medical school.

DR. A. GRAHAM LUSK, professor of physiology at the University and Bellevue Hospital Medical School has been appointed professor of physiology in the Cornell Medical College.

DR. DANA B. CASTEEL, instructor in zoology in the University of Michigan, has been appointed instructor in zoology in the University of Texas.

CAPTAIN H. G. LYONS, F.R.S., director-general of the survey of Egypt, has been appointed lecturer in geography at the University of Glasgow.

DISCUSSION AND CORRESPONDENCE

THE LAW OF RADIATION

TO THE EDITOR OF SCIENCE: Is it worth while to keep on upholding certain theories, and to wholly neglect certain new facts which tend to undermine the very foundation on which these theories rest? What justification

is there, for instance, in declaring that my "definition for temperature"[1] is erroneous without an accompanying proof showing that Newton's law of radiation is also erroneous? As this particular matter stands, Dr. Reid has simply made a dogmatic assertion, for if Newton's law is true (and I claim to have demonstrated that it is true) it follows as a theoretical necessity that *absolute temperature is a direct measure of the intensity of ether vibration.* If Stefan's law, or any other law except Newton's, can be demonstrated to be true, then, and then only, will scientists be justified in summarily condemning my conclusions.

J. M. Schaeberle

Ann Arbor, Mich.,
January 4, 1909

[1] Science, January 1, 1909, p. 29.

AMERICAN SCIENTIFIC PRODUCTIVITY

It is well that we should be reminded by Professor Nichols in his presidential address before the American Association (Science, January 1, 1909) and by Professor Pickering in his articles in *The Popular Science Monthly* (October, 1908, and January, 1909) that the scientific work accomplished in this country is not commensurate with its population and its wealth, and that Professor Willcox (Science, January 29, 1909) should reinforce this fact from the awards of the Nobel prizes.

But while we can not too strongly emphasize the circumstance that we are not doing all that we should for the advancement of science and that this is partly due to the fact that the scientific career is not made sufficiently attractive to obtain and retain the best men, nor sufficiently free to enable them to do their best work, it yet seems that the situation is by no means discouraging. The articles mentioned measure our scientific productivity by the eminent men we have. In so far as this is an adequate method, it tends to measure our activity a generation ago; for men do not usually obtain international recognition until long after the work for which it is given has been accomplished.

Professor Pickering finds that of the 87 scientific men who are members of at least two foreign academies only six are Americans. Each of the two eminent American men of science who is a member of the largest number of academies is in his seventy-third year. It is a striking fact that of the six distinguished Americans, three are astronomers; and astronomy is the only science in which thirty years ago the facilities for research work in this country were equal to those of the leading European nations. Of the remaining three, two have not been engaged in teaching, and the third has been practically freed from teaching for his research work. We may have, in accordance with Professor Pickering's data, but six scientific men as distinguished as 17 in Prussia, 13 in England and 12 in France, but this would represent the relative scientific activity of the country at the time when our universities were only beginning to develop and when research work under the government was only beginning.

The Nobel prizes have, contrary to the instructions of the founder, been, as a rule, awarded to eminent men for work done in the past; and the fact that of twenty-four prizes in the sciences only one has come to America does not discredit our present scientific research. If the provision of Nobel's will had been followed and the prize had been given to the person "rendering the greatest service to humanity," by "having made the most important discovery or invention in the department of physical science," the first two awards should probably have been to Mr. Bell and Mr. Edison.

It is a curious fact that the three subjects in which the Nobel prizes are awarded—physical science, chemistry and medicine—are those in which we are particularly weak. These are the sciences in which the applications are the most direct, and it looks as if those competent to advance these sciences had been carried into practical work. This is contrary to my preconceptions, for I should suppose that when there are large opportunities for practical work, there should also be advances in pure science. Perhaps it is only individual eminence that is here lacking, and we are in fact contributing our share to

The choir invisible
Whose music is the gladness of the world.

We seem to do better in the natural sciences. In geology, zoology, botany, anthropology and psychology, there is probably more research work published here than in any other country except the German empire and the amount of research work published is the most tangible, and perhaps the most exact, measure of scientific activity. I have found that in the *Zeitschrift für Psychologie* there have been more articles in experimental psychology reviewed (selected as the more important articles) from America than from the German-speaking nations combined, and more than ten times as many as from Great Britain. We have also, according to the criterion of membership in foreign academies, the most eminent living psychologist.

The statement made by Professor Nichols and endorsed by Professor Willcox that "the men who have laid the foundations upon which civilization is built have nearly all been teachers and professors" appears to be more correct for Germany than for England. Darwin did not teach, and not one of the five scientific members of the Order of Merit—Hooker, Huggins, Lister, Rayleigh and Wallace—is a teacher. It is a remarkable fact that while Germany has excelled in the quantity of research work accomplished since the development of its universities, England has produced the greatest leaders. The elementary teaching required in our collegiate universities not only absorbs time and energy, but also tends to develop a superficial omniscience and a dogmatic attitude unfavorable to investigation. If we add to this the clerical, administrative and missionary work, which the university president crowds on the university professor, and the distracting need of earning enough money to support his family, there is perhaps reason to wonder that he accomplishes as much research work as he does accomplish.

Fortunately there has been within thirty years a great increase in this country in the number of positions permitting scientific work, and in the opportunities which these positions offer for research work. Many of our universities have admirable laboratories, and there is certainly a strong sentiment in favor of permitting the professors to use them. We are gradually obtaining university laboratories analogous to the astronomical observatories, where professors will only do so much teaching as is favorable to their investigations. At the same time there has been a notable development of scientific work outside the universities, under the national government, under states and municipalities, in technological work, and recently in the establishment of research institutions such as the Carnegie Institution of Washington and the Rockefeller Institute for Medical Research. The material foundation is already adequate and will be rapidly enlarged. What we need is more men with the ability and spirit which research work demands.

J. McKEEN CATTELL

SCIENTIFIC BOOKS

Qualitative Analyse vom Standpunkte der Ionenlehre. Von Dr. WILHELM BÖTTGER, Privatdozent und Oberassistent am Phys.-Chem. Institut der Universität Leipzig. Zweite, Umgearbeitete und Stark Erweitete Auflage. Leipzig, Wilhelm Engelmann. 1908.

The first edition of this book was published in 1902. An English translation by Smeaton appeared in 1906, a book of 300 pages. This second German edition is a stately volume of 524 pages; it contains nearly double as much matter as its predecessor and is quite different in arrangement.

The fundamental general and ionic theory is in a division by itself, forming the first 116 pages of the book, and is illustrated by simple but ingenious and instructive experiments, thirty-five in number. These experiments alone would give the book permanent value, but it is worthy of study throughout.

In the chapter on systematic analysis, for example, a method is given, familiar in detail but new in application, for separating the cations of group III.; after treatment of the sulphides with dilute HCl, and filtering, the filtrate containing Al, Cr. Fe, Mn, Zn and

traces of Co and Ni, is heated to drive off H_2S, and cooled; it is then treated with an excess of KOH, oxidized with Br water or H_2O_2, and filtered. The residue may contain $Fe(OH)_3$, MnO_3H_2, and traces of $Cr(OH)_3$, $Co(OH)_3$, $Ni(OH)_3$. The filtrate may contain K_2CrO_4, AlO_3K_3 and ZnO_2K_2. The Cr is tested for by oxidizing an acidulated portion of the filtrate to perchromic acid by H_2O_2. Another portion of the filtrate is exactly acidulated with HCl, and precipitated by sodium acetate as aluminium basic acetate, thus securing the detection of very small amounts of Al. The filtrate from the oxyacetate contains the Zn which is precipitated as sulphide by H_2S. Iron and manganese are tested for by dissolving one portion of the residue in HCl, and adding KCNS, or $Fe(CN)_6K_4$, and by fusing another portion of the residue with $Na_2CO_3 + KNO_3$. The presence of traces of compounds of Cr, Co, Ni, not interfering with these tests. This method will be found simpler, shorter, and fully as accurate as the barium carbonate method, which is so generally recommended, when Cr, Mn and Fe are all present in the substance analyzed.

In the chapter on solutions the treatment of sulphides and chlorides insoluble in acids is noticeable.

In the chapter on preliminary treatment the introduction of the Hempel reduction methods is praiseworthy.

The phase-rule is entirely omitted; just why it is hard to see. One may say that beginners can not understand it, but this is not a book for beginners. However, as Dr. Böttger is chief assistant in the Leipsic laboratory, he must be credited with due consideration of the theories to be introduced or omitted.

Elementary physical chemistry throws such a flood of light on the problems of analysis that the opponents of its use for this purpose are fewer every year; although among the new manuals are some which practically differ from the older books only in adding the word "ion" to the name of the element, and freely using + and — signs; such books do not illuminate and make no converts.

The present book, it is true, is too large and too detailed for American college students, but any one who intends to write a laboratory manual—and who does not write one?—will do well to read Dr. Böttger's book carefully.

It would be well if the author should arrange with his American translator to publish an abbreviation of this book for college use, containing the theoretical part and experiments without change, but cutting down the remainder to a third of its present size. This is practicable, as much of the present material should be omitted for college use, and as Dr. Böttger's German is extremely diffuse. Such a book would be very valuable for college students in their second laboratory-year.

The book, as it is, should be studied by graduate students, and especially by teachers, who will find in its pages simple explanations of more than one puzzling phenomenon. It is to be hoped that the book will meet with the recognition which it merits.

E. RENOUF

A Treatise on Chemistry. By H. E. ROSCOE and C. SCHORLEMMER. Volume II.: The Metals. New Edition, completely revised by H. E. ROSCOE and A. HARDEN. Pp. xii + 1436. New York, The Macmillan Company.

Sir Henry Roscoe is to be congratulated most heartily on the revision of the well-known "Treatise on Chemistry." It is seldom that an author lives to see such an extensive work useful through thirty years and at the end of that time appear entirely fresh with all of the most recent developments in theory and application. The book bears the strong personal impress of the author and is delightful reading on account of the intimate historical presentation of the various subjects. The scientific, practical and historical are so nicely interwoven as to make the book most readable and valuable.

The introduction of material on Werner's valence theory, the phase rule, radio-activity, Thomson's corpuscular theory and other recent developments has added much to the value of the book. In addition to these an account of recent work on alloys has been added, although the treatment is not entirely satisfac-

tory. The brief reference to such an important subject as the constitution of steel is to be regretted.

The subject of crystallography, which was formerly given in the volume of the non-metals, has been transferred to this volume and occupies fifty pages. It is fully believed that such special subjects as this and spectrum analysis (25 pages) might be condensed into much smaller space without injuring the value of the book.

The metallurgical and technical processes, as in previous editions, have been satisfactorily treated, and have been brought up to date.

While the chemists will be pleased to have so excellent a statement of his science as this book, he will regret that the author has not drawn more largely from his long experience and given more attention to criticism and generalization.

HENRY FAY

Lead and Zinc in the United States, Comprising an Economic History of the Mining and Smelting of the Metals, and the Conditions which have affected the Development of the Industries. By WALTER RENTON INGALLS. Pp. x + 368, illustrated. New York, Hill Publishing Co. 1908. $4.

Most publications dealing with the histories of metals have mainly an antiquarian interest. The two leading exceptions to this general rule are found in the great work of Beck on iron, and the more general book of Neumann on the leading industrial metals, as both authors have taken up the statistical, industrial and technical sides, and added them to the usual chronological treatment of the subject.

The present work deals with lead and zinc only, the ores of which frequently occur together and therefore influence each other in treatment. The new departure of this publication lies in the fact that, restricting the field to the United States, it considers the American methods of treatment of the metals from the mine through the smelter to the market of the finished product. The technical processes are given with sufficient details to be clear even to the reader not especially versed in this branch of engineering.

The time of writing such a work is opportune, as some of the founders of the modern American lead-smelting practise are still actively engaged in their profession, and as the fathers of the first industrial production of zinc are still living; nor could the work have fallen into better hands than those of the author, who is well-known to the mining and metallurgical profession as an engineer, as a writer on subjects relating to lead and zinc, and as the editor of one of our leading technical journals and annuals.

The introduction gives a brief and concise review of the history of the two metals in this country. The first part, which deals with lead, is much longer than the second, devoted to zinc. This was to have been expected, as while lead was first mined in the early part of the seventeenth century, zinc was not produced until two centuries later.

The history of lead begins with an account of the occurrence of lead ores. The discussion outlines the leading geological features of the deposits, but dwells more upon the character and grade of the ores, and upon the industrial conditions which governed the mining operations. This is followed by the chronology of the history of lead-mining, which starts from the first record of 1621, when lead was mined and smelted near Falling Creek, Va., and records the leading events down to 1906. Chapter III. gives a valuable résumé of the development of the blast-furnace practise of smelting silver-bearing lead ores, and of the treatment of silver-free lead ores in the ore-hearth and the reverberatory furnace. It shows how blast-furnace smelting developed from crude beginnings into its present unsurpassed excellence by the application of science to art, and by concentration of operations into large, centrally located plants. In the account of the ore-hearth work the increase in yield by the recovery of fumes receives due consideration. While in smelting the work of Arents, Eilers, Hahn, Raht and others is recorded, in the chapter on refining we should have liked to see mentioned the invention of the Steitz siphon,

which changed the refining practise as did the Arents siphon tap the blast-furnace work, and the systematization of the complications in the Parkes process, which is more largely due to E. F. Eurich than to anybody else, and which forms the basis of the modern American practise. We miss also any record of some early eastern refineries, as, *e. g.*, the Delaware Lead Works at Philadelphia, and other smaller plants around New York. Chapters V.–XII. give a detailed history of the mining and metallurgical operations of the several states and territories. The production of metal at different periods is usually given, although in some cases, *e. g.*, in Montana, the data are missing. The remaining 55 pages of the 255 given to lead deal with the statistics of production, consumption and prices, with the commercial conditions, the tariff on lead, the labor conditions and with trade agreements and combinations.

The second part, which takes up 90 pages, treats of the history of zinc according to the same general plan as followed with lead. The mechanical concentration of zinc ores, which plays such an important part in the treatment, receives a separate chapter. The chapter on the metallurgy of zinc, the author's specialty, contains a critical review of the different types of distilling furnaces which have been and are used in this country; it is a chapter which every metallurgist will study with profit and pleasure.

The book, as a whole, is most satisfactory, as it is replete with valuable information presented in an interesting way. Last, but not least, it has a full index which enables the student to look up points upon which he desires enlightenment.

H. O. HOFMAN

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for January begins with the first part of a paper by Robert F. Griggs, on "Juvenile Kelps and the Recapitulation Theory." J. Stafford describes "The Larva and Spat of the Canadian Oyster," giving special attention to the microscopic stages mostly omitted in the work of W. K. Brooks. Waldemar Jochelson presents some interesting notes on "Traditions of the Natives of Northeastern Siberia about the Mammoth" and there are other notes on "The Age of Trotting Horse Sires" and "The Influence of Environment upon Animals."

The American Museum Journal for January has articles on "The Duck Hawk, Hackensack Meadow, and Egret Groups," "Two Noteworthy Museums" (the Congo Museum, Brussels, and Senckenburg Museum, Frankfurt), "The International Tuberculosis Exhibition" and "An Ethnological Trip to Lake Athabasca," besides notes, lists of members elected since the last issue, and the lecture announcements.

The Bulletin of the Charleston Museum for December gives an account, with plan, of "The New Building" which contains the collections, library and lecture room. A note on "The History of the Museum" shows that so late as 1843 it was still under the auspices of the Literary and Philosophical Society of Charleston.

The Museum News of the Brooklyn Institute for January contains an article on "The Hoatzin," by Geo. K. Cherrie, which gives a very full account of this interesting bird and includes a considerable amount of new information gathered by Mr. Cherrie. A note on the leather-back turtle given by the New York Aquarium, states its weight to have been a little over 840 pounds; extreme length, following curve, 6 feet, 10 inches, from flipper to flipper over shoulders, 8 feet, 9 inches. The Children's Museum section gives "Some Evidences of Progress in 1908" in the matters of increased attendance by both children and teachers, and an increasing use of the collections and library.

BOTANICAL NOTES

PHYSIOLOGY AND ECOLOGY

ALFRED DACHNOWSKI's brief paper on "The Toxic Property of Bog Water and Bog Soil" (*Bot. Gaz.*, Aug., 1908) is an attempt to contribute something to the solution of the problem of bog conditions so far as vegetation is concerned. Studies were made of a bog island in Buckeye Lake in central Ohio which ap-

peared to confirm the observer in the view that bog-water does contain toxic substances.

Geo. F. Freeman tells (*Bot. Gaz.*, Aug., 1908) of "A Method for the Quantitive Determination of Transpiration in Plants," which consists in using phosphorus-pentoxid U-tubes through which a current of air is drawn by an aspirator. This air current previously flows over the enclosed foliage of the plant under examination, and the moisture which it contains (as a consequence of transpiration) is absorbed by the phosphorus-pentoxid. The increase in weight of the latter enables the experimenter to determine the amount of transpiration.

Somewhat like the preceding is Dr. G. J. Peirce's paper on "A New Respiration Calorimeter" (*Bot. Gaz.*, Sept., 1908) in which after pointing out some errors and crudities in some popular lectures and experiments he describes the simple apparatus which he has found useful. Dewar flasks (with double walls enclosing a vacuum) were used, and it was found that these when silvered enabled the experimenter to obtain results that were quite impossible with other apparatus. Dewar flasks are also popularly known as "thermal bottles," but those supplied in chemical glassware are more serviceable and less expensive.

The question of the effect of illuminating gas upon plants is one of much popular interest and has been investigated by Messrs. Crocker and Knight and the results published in a paper ("Effect of Illuminating Gas and Ethylene upon Flowering Carnations") in the *Botanical Gazette* for October, 1908. They find that one part of gas in 40,000 parts of air kills the young flower buds, and that 1 part of ethylene in 1,000,000 parts of air is harmful.

J. F. McClendon's paper "On the Xerophytic Adaptations of Leaf Structure in Yuccas, Agaves and Nolinas" (*Am. Nat.*, May, 1908) brings together a number of interesting structural details in regard to the epidermis, stomata and general leaf-structure of these plants.

Here should be noticed Professor L. H. Harvey's very helpful paper on the "Floral Succession in the Prairie-grass Formation of Southeastern South Dakota" (*Bot. Gaz.*, Aug. and Oct., 1908) in which he gives a good idea of the vegetation of the region by an unusually clear discussion, aided by carefully selected photographs.

A suggestive paper entitled "A Study of the Variation of the Number of Ray Flowers of Certain Compositae" by Mr. W. Dudgeon recently appeared in the *Proceedings of the Iowa Academy of Sciences* (Vol. XVI.), in which the author shows by careful counts of several thousand heads from different localities, first, that there is a wide variation in the number, and second, that the highest numbers are the same in the different localities. Thus in *Rudbeckia hirta* the rays range from 2 to 28, with the greatest number of heads having 13. *Rudbeckia triloba* ranges from 5 to 14, with 8 as the normal, while in *Helianthus grosse-serratus* the range is from 7 to 25, with 13 as the normal.

Dr. Henri Hus contributes a paper in the February *American Naturalist* to the obscure subject of teratology, under the title of "Fasciations of Known Causation," in which he enumerates four "causes": (1) mechanical, (2) cases where no injury can be traced, (3) fungi, (4) insects. In his paper these are discussed at length, and numerous examples are cited.

ECONOMIC BOTANY

F. C. STEWART, of the New York Agricultural Experiment Station (Geneva), prints an instructive summary of the botanical investigations made in the station during the past twenty-five years. And it is an excellent record, and had the station accomplished no more in this time than is here enumerated in one department alone, it would have fully repaid the state for the money expended. On looking over the paper one is amazed at how much has been done in these twenty-five years. The diseases of more than thirty kinds of plants have been studied, including most of the standard crops of the state, as apple, asparagus, bean, beet, cabbage, carnation, cauliflower, celery, etc. The alphabetical arrangement makes it easy to find what has been done in the study of the diseases of this or that

plant. Incidentally it becomes a handy reference to the literature of the plant diseases investigated at this station.

H. S. Jackson's address on the "Development of Disease-Resistant Varieties of Plants," given before the Massachusetts Horticultural Society, March 14, 1908, and printed in its proceedings, is a clear popular discussion of a most important but poorly understood subject. Recognizing that "spraying is a nuisance at best" the speaker urged that more attention should be given to the development of varieties which are resistant to disease, suggesting (*a*) the selection of individuals, (*b*) the selection of varieties and (*c*) hybridization followed by selection of varieties and individuals. Brief discussions of what has been accomplished in regard to wheat, clover, cow peas, potatoes, tobacco, cotton, etc., are given which will astonish those who have not followed the work of the last few years; the difficulties are candidly pointed out, and something is said as to the cause of immunity, and the possibility of artificial immunity.

Dr. E. M. East's paper, entitled "A Study of the Factors Influencing the Improvement of the Potato" (Bull. 127, Ill. Expt. Station) is valuable not only from a practical standpoint, but also for the history of the potato which is given in the introductory pages. After this, methods of breeding, inheritance of characters in tuber selections (in which the author regards the gain as doubtful), degeneration of varieties (the author concluding that varieties do not run out), mutations, etc., are taken up in succession. The author suggests three possible methods of improvement, viz., (1) crossing of desirable plants, (2) selections of the most desirable fluctuations among the plants and tubers of a variety, (3) selection of discontinuous variations and a study of ways of causing them, and regards the first as most promising.

Here should be noticed J. E. Rockwell's "Index to Papers relating to Plant-Industry Subjects in the Year-books of the United States Department of Agriculture," which will save much time and labor to the botanist who has occasion to refer to the many valuable botanical papers published in the agricultural year-books.

Three recent papers by Dr. Kraemer in the *American Journal of Pharmacy* are of interest to the plant histologist as well as the pharmacist, viz., "Microscopical and Chemical Examinations of Black Pepper," the same for commercial ginger, and some distinguishing characters of belladonna and scopolia. Each paper is well illustrated by many clear figures.

CHARLES E. BESSEY
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SPECIAL ARTICLES

SEX DETERMINATION AND PARTHENOGENESIS IN PHYLLOXERANS AND APHIDS

THE phylloxera of the hickories offer exceptional opportunities for a study of sex-determination and parthenogenesis. In some species three generations can be followed within the same gall—two parthenogenetic and one sexual. We can determine the number of males and females that have descended from the same fertilized egg, as well as the influence of external conditions in affecting the number and kind of individuals in each generation. Immense numbers of eggs can be obtained. They furnish also excellent, although difficult, cytological material.

During three years I have studied the cytological aspects of the life cycle and can now present an almost complete account of the remarkable chromosomal changes that occur in connection with sex-determination.

I wish to lay especial emphasis on three points:

1. In many insects it has been found that sex is connected with, or produced by, two kinds of spermatozoa. But in phylloxerans, aphids, bees, ants, in certain saw-flies, in daphnians and in hydatina, the fertilized eggs produce only females. In the phylloxerans and aphids the result is connected with the formation of only functional female-producing spermatozoa—the male-producing sperms degenerate. One may suspect that similar conditions are to be found in the other groups, and the facts of spermatogenesis in the bee, wasp and ant, support such a view.

2. The females that result from the fertilized egg produce subsequently both males and females parthenogenetically. Clearly the egg as well as the sperm contains factors that determine sex. I have found, in fact, that the same method used by the sperm is also made use of by the egg.

3. I wish to raise certain questions connected with the mechanism by means of which males and females are produced. It has generally been assumed that chance alone determines into which sperm the sex chromosome passes. There are indications in the egg that this mechanism is not a chance result, but that behind it lie a series of preliminary events that are equally to be reckoned with as sex-determining factors.

The life cycle of a typical species of phylloxeran consists of the stem-mother (arising from the fertilized winter egg), of a second winged generation (produced by the stem-mother), and of sexual males and females—mere pigmies in size—that come from the winged individuals. The winged individuals are of two kinds, those bearing large eggs that produce the sexual females, and those bearing small eggs that produce the males. Certain species deviate from this rule. I shall refer to one such species later.

Phylloxera fallax has the following chromosomal history. The polar spindle of the egg laid by the stem-mother has twelve chromosomes. One polar body is extruded. Twelve chromosomes remain in all of the eggs and are found in the somatic cells of the winged generation.

The polar spindle of the female egg laid by a winged individual contains twelve chromosomes. One polar body is extruded, and twelve chromosomes remain in the egg to give this number to the somatic cells of the sexual female.

The polar spindle of the smaller male egg also contains twelve chromosomes. One polar body is given off. Ten chromosomes remain in the egg, and this number characterizes all of the body cells of the male, as well as the spermatogonial cells. Evidently two chromosomes have disappeared when the polar body is produced.

In the first spermatocytes six chromosomes appear. At the first division four of these divide equally, but two do not divide; they are the accessories or sex chromosomes and pass to one cell. This cell becomes the functional sperm; the other, containing four chromosomes, degenerates. At the second spermatocyte division all six chromosomes in the functional spermatocyte divide equally, so that each of the two spermatozoa gets six chromosomes.[1]

The sexual egg contains a polar spindle of six chromosomes. Presumably two polar bodies are formed and six chromosomes remain in the pronucleus.

With these facts we can reconstruct the life cycle of the chromosomes.

Egg 6 Sperm 6
Stem Mother 12
Polar body 12

Female Producer 12	Male Producer 12
Polar body 12	Polar body 12
Sexual Female 12	Male 10
Sexual Egg 6	Functional Sperm 6

Before commenting on these results I wish to call attention to another species, *Phylloxera caryæcaulis*.

In this species there are six chromosomes in the polar spindle of the egg laid by the stem-mother. One polar body is extruded. The somatic cells of the embryos contain six chromosomes.

The polar spindle of the female egg contains six chromosomes. Six are given off in the single polar body, and six remain in the egg.

The polar spindle of the male egg also contains six chromosomes, *but they are of different sizes from those in the female egg.*

[1] In the aphids also two kinds of spermatozoa are formed. The accessory—single in this case—passes into only one of the spermatocytes. This fact I determined in the winter of 1907–8 and von Baehr and Stevens have also reached the same conclusion (1908).

Six (or more) are given off in the single polar body, but only five are found in many of the male eggs—others contain six (five large and one small). I shall clear up this difficulty later.

In the spermatocytes three chromosomes often appear—at other times four. There are found one or two accessory chromosomes. One cell gets three—or four—the other always two. The former produces the functional sperm; the latter degenerates.

In the second spermatocyte all the chromosomes divide equally in the functional cell. The rudimentary cells do not divide, and later degenerate.

The occurrence of two kinds of males with five or six chromosomes and of two kinds of spermatocytes has given endless trouble and has delayed publication for nearly a year. The facts seem to be these. Eight, not six, is the full number for this species. Two of these chromosomes, one large and one small, often unite. In fact these two are the two accessories and practically always unite to produce a single accessory separating in some individuals as they move into the functional cell. The sexual egg contains four chromosomes. We can construct the chromosomal history as follows:

Egg 4 (3) Sperm 4 (3)
Stem Mother 8 (6)
Polar body 8 (6)
Female Producer 8 (6) Male Producer 8 (6)
Polar body 8 (6) Polar body 8 (6)
Female 8 (6) Male 6 (5)
Sexual Egg 4 Functional Sperm 4 (3)

The most important fact brought out by these results is that in the male egg a redistribution of the eight chromosomes occurs, so that the two small ones pair, and their mates, the two large ones, also pair. This union is evidently preparatory to the extrusion from the male egg of two entire chromosomes which reduces the number in the male by two.

We catch a glimpse here of a mechanism preceding the differential division of the chromosomes that determines the production of males.

This discovery suggests many further questions. I shall call attention to but one—the most important.

In both species we see that male eggs and female eggs are determined as such before there is any loss of chromosomes. The total number of chromosomes is present, yet one egg is large and the other small. The preliminaries of sex-determination for both sexes go on in the presence of all the chromosomes. The male itself is *produced* only *after* the elimination of two of the sex chromosomes, but the sexual female and the parthenogenetic female are both produced in the presence of all of the chromosomes. Clearly, I think, the results show that changes of profound importance may take place without change in the number of chromosomes. Equally clearly emerges the fact that the male develops after the loss of two chromosomes. This latter result shows that in the male parthenogenetic egg sex is connected with the same process found in the sperm of other species of insects.

In conclusion I wish to call attention to the sex ratios in the two species referred to.

Phylloxera fallax produces its sexual forms within the galls. The males and females crawl out of the galls, that open to allow their exit, pair, and deposit the eggs on the stems. A count showed that to 1,067 female eggs there were 1,049 male eggs in the galls—nearly an equality in number of the sexes.

Phylloxera caryæcaulis, on the other hand, produces winged forms that leave the gall and fly out in the air. Those that alight on the leaves of the hickory deposit their eggs on the under sides of the leaves. In this species a count of eggs *on the leaves* gave 1,316 male eggs and 296 female eggs, *i. e.,* nearly 4.4 to 1. More important are the counts of male and female *producers* within each gall. A large number of such counts have been made, of which the following give a fair idea: These results show a large preponderance of male producers; they also show that in some cases only male producers appear and in one

Male Producers	Female Producers	Male Producers	Female Producers
120	1	220	0
23	8	300	14
331	105	185	0
32	1	127	0
106	2	219	29
152	177	209	9
291	0	0	328
240	0	3	386
323	3		

case only female producers. When it is recalled that all the descendants can be traced to a single egg fertilized by a "female-producing" sperm the results are significant. It is obvious that while the sex of the fertilized egg is connected with the "female-producing" sperm, the subsequent progeny may be either males or females or a mixture of both. Either external conditions determine the result (for which there is no evidence), or else there is a strong "prepotency" of the egg or sperm in one or the other direction.

When it is recalled that the division into male layers and female layers takes place one generation prior to the formation of the sexes, it will be manifest that the conditions that determine the proportion of males and females, *i. e.*, sex-determining factors, are to be sought in a mechanism that lies behind the one that excludes two chromosomes from the male egg.

Equally important is the fact that in the latter process of elimination the result is not haphazard, for the eliminated chromosomes always pass into the polar body of the male egg. Since we can identify this egg before the elimination, we know that we are dealing here also with an ordered series of events, and not with an accidental shifting of chromosomes into one or another cell.

T. H. Morgan

Columbia University

MOMENTUM EFFECTS IN ELECTRIC DISCHARGE

In Science of July 17 and December 4, the writer has given some account of experiments which seem to indicate momentum effects, in electrical discharges around a right angle in a wire. One interesting feature of the work was the formation of shadow pictures of thin glass slides upon which lines had been scratched. At the Baltimore meeting of the American Association for the Advancement of Science, a series of these pictures was shown, some of which were of special interest.

A sheet of hard rubber one sixteenth of an inch in thickness was pierced with a large number of holes of various diameters. This sheet was laid upon the photographic film within a hard rubber holder. The wire angle from which the fogging effects came was just above the cover, and about 5 mm. from the film. The holder rested upon a sheet of glass, 2 or 3 cm below, which was a grounded metal plate. The film was more strongly fogged at the bases of the larger holes than at those of the smaller ones. The electrons were apparently deflected to the sides of the smaller holes to such an extent that few of them reached the film at the bottom. Holes directly below the wire gave images with sharp outline. Those to one side gave images having on the sides remote from the wire diverging lines indicating the repulsion of the accumulating electrons on the film by the wire above, and their repulsion for each other. The comparison of such shadow images with those made by light shining through the same holes showed differences of a very marked character.

Another interesting shadow picture made just before leaving home, was produced by replacing the pierced rubber plate by small fibers of glass, laid on the film at right angles to the wire above. These fibers were about half a millimeter in diameter. Some of them were hollow tubes and some were solid. The tubes gave shadows of uniform density. The solid fibers showed conclusive evidence of refraction. In every case the shadow image shows a sharp black line along its center, where the fiber made contact with the film.

Wood, of Johns Hopkins University, suggested that this might indicate the presence of high frequency ether waves, and suggested the use of red or yellow glass, with the other glass fibers.

On returning home Wood's suggestion was carried out. After many attempts two fibers of glass, the one of colorless and the other of red sealing in glass, each having the same diameter, were prepared. This diameter was 0.079 cm. The red glass gave a slightly less sharply defined focal line. There is little if any absorption. By pushing the exposure, diverging discharge lines were shown at either end of the block focal line. This gives unmistakable evidence of the action of negative electrons.

On using a red rod of diameter 0.420 cm. the shadow picture showed white along the line of contact with the film. The absorption was then complete.

Francis E. Nipher

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

The 422d regular meeting, on October 13, 1908, was addressed by Major Charles E. Woodruff, surgeon, U. S. A., on "Anthropological Studies on the Effects of Light."

Major Woodruff briefly reviewed the various advances which have been made in the study of the effect of light on organisms. He gave special attention to the value of light in the treatment of tuberculosis. It was thought, said Dr. Woodruff, that fresh air, good food and abundance of light, were the three most beneficial things in the treatment of this disease. He had reached the conclusion that the last factor was harmful, and that the success of certain cloudy regions was due to the lesser degree of light; and that brilliant deserts increased the mortality to an alarming extent.

The paper was discussed by Professor McGee, Dr. Hrdlička, Dr. Lamb and others.

The 423d regular meeting, on November 10, 1908, was a memorial meeting for Professor Otis Tufton Mason, of the National Museum, whose death occurred on November 5. Appropriate remarks on his life and varied activities were made by Dr. Theodore Gill, Dr. F. W. True, Dr. Aleš Hrdlička, Mr. Charles K. Wead and several others. Dr. Hrdlička read from the autobiography which Professor Mason had prepared several months before his death.

At the 424th regular meeting, on November 24, 1908, Dr. Aleš Hrdlička gave a synopsis of the results of his investigations among the various Indian tribes of the United States for the International Congress on Tuberculosis.

Doctor Hrdlička visited the Winnebago, the northern Sioux, the Quinaielt, the Hupa and the Mohave tribes. Among all these peoples, Dr. Hrdlička describes the conditions as most appalling, giving rise to the belief that in a few years these tribes will be wasted to small remnants. The housing, food and personal habits are of the most primitive character, and there seems to be an utter disregard of all rules for the prevention of the spread of tuberculosis. Perhaps the most alarming conditions were found among the virile Sioux, who are rapidly succumbing to this dread disease. He held that in most cases the ultimate cause of the ravages of consumption among the Indians is due to the adoption of clothing, houses, food, etc., of the whites, and the lack of knowledge as to the communicability of disease.

The results of Dr. Hrdlička's researches will be published in the forthcoming report of the International Congress on Tuberculosis.

At the 425th regular meeting, on December 22, 1908, Dr. J. W. Fewkes read a paper illustrated with lantern slides on the excavation and repair work at Casa Grande, done by the Smithsonian Institution during the past two winters. The prehistoric settlement, of which Casa Grande is the best preserved building, was found to include several rectangular walled enclosures (compounds) in an area of several acres. Five of these compounds were excavated and repaired. Views were shown of mounds before excavation and others illustrated bird's-eye views of the same in their present condition.

The character of the repair work, especially the means adopted to preserve the walls from the elements was described and illustrated.

At the 426th regular meeting, on January 5, 1909, the following program was presented:

"Expedition to Sian-Fu, China, to Procure a Replica of the Nestorian Tablet," by Mr. Fritz Von Holm.

This tablet is dated A.D. 781 and contains an inscription of about 2,000 Syriac characters giving the part of Asia from which this body of Christians had come, a list of the benefits conferred on them by the Chinese emperors and other matters of historical importance. It was discovered in modern times in 1625 and set upon a stone pedestal in the shape of a turtle, but although visited occasionally, little care was taken of it until 1907, when the interest excited by Mr. Von

Holm's journey induced the officials to remove it to the Peilin or "forest of tablets," where it will be protected from the weather and its life prolonged many years. Mr. Von Holm recounted the interesting details of his expedition, the various difficulties which beset his work and the final deposit of the replica in the Metropolitan Museum of Art in New York. The lecture was illustrated by about forty excellent lantern slides.

"Remarks on Nestorianism," by Dr. I. M. Casanowicz.

This address was largely in illustration of the paper preceding, and consisted in a brief review of the past history and present condition of the Nestorian sect. Unlike most Christian bodies, Nestorians were fostered by both Persians and Arabs, and at the zenith of their power under the latter the Catholicos, or supreme head of the Nestorian Church, had under him twenty-five metropolitans, each of whom in turn was over not less than five bishops. Nestorians penetrated to China, Ceylon and India, where they were found by the Portuguese and are known as Christians of St. Thomas. At the present time a portion of the Nestorians of southwestern Asia have united with Rome, while those who still maintain their independence, numbering about 70,000, have been the object of labors by Protestant missionaries from England and America.

At the 427th regular meeting, on January 19, 1909, Mr. Juul Dieserud presented a paper on "The Scope and Content of the Science of Anthropology." Mr. Dieserud was originally led to take up this problem in cataloguing scientific works, first at the Field Columbian Museum, Chicago, and later at the Library of Congress. His attitude was, therefore, that of the librarian and not of the working anthropologist, and was governed by a study of the attempted classifications of professional anthropologists as compared with the actual works requiring classification. It followed closely, though with elaboration in many points and condensation in others, the course of his argument in his book bearing the same title.

The paper was discussed at some length by Professor McGee, Dr. Fewkes, Dr. Swanton and Dr. Folkmar.

WALTER HOUGH,
Secretary

THE GEOLOGICAL SOCIETY OF WASHINGTON

At the 210th meeting of the society, held on Wednesday, November 25, under informal communications, Mr. Ernest A. Shuster described briefly the original boundary stones of the District of Columbia.

Regular Program

The International Geographic Congress: Mr. DAVID T. DAY.

The Correlation of Sections Lithologically Similar: Mr. WILLIS T. LEE.

A geologic section of the coal-bearing rocks of the Grand Mesa coal field of central western Colorado, hitherto referred to the Mesaverde, was shown to be strikingly similar to the section, in the Raton coal field of New Mexico, of rocks hitherto referred to the Laramie. The evidence on which the correlations have been based is not conclusive and attention was called to the desirability of reexamining it in the light of new evidence. The recently discovered facts likely to influence the revision of correlations are: (1) a line of unconformity discovered a year ago (1907) in the Grand Mesa field separating the coal-bearing rocks into an upper and a lower member; (2) a similar line of unconformity discovered during the present season (1908) in the Raton field separating the coal-bearing rocks into two formations and (3) the stratigraphical evidence and fossil plants collected from both formations apparently indicate that the unconformity in the Raton field represents a period of erosion comparable to the post-Laramie erosion in the Denver basin.

Coon Butte or Meteor Crater: GEO. P. MERRILL.

The region of Coon Butte, near Canyon Diablo, is underlain by a light gray to buff Carboniferous (Aubrey) limestone some 200 feet in thickness, this by a light gray saccharoidal sandstone of not above 500 feet in thickness, and this, again, by a red-brown sandstone of undetermined thickness. These rocks lie nearly horizontally and are little disturbed.

The crater was described as roughly circular in outline and nearly 4,000 feet in diameter. The crater rim at its highest point is 160 feet above the level of the plain and the present bottom some 350 feet below. The rim is composed wholly of sharply upturned edges of the limestone, covered with fragments of the same, as well as fragments of the underlying sandstone, in sizes varying from microscopic to those weighing thousands of tons. Exteriorly the crater rim slopes gradually away to the plain. Interiorly the broken edges of the upturned limestone form steep,

and often perpendicular, walls. Borings made from the crater bottom vertically downward to a maximum depth of some 1,100 feet pass through a comparatively thin layer of lake bed material and talus (rarely 100 feet in thickness) into a zone of rock flour composed of the shattered granules of sandstone, and thence, at depths of about 650 feet below the crater bottom, into firm red-brown sandstone. No traces whatever were found of the ordinary volcanic products, as lava or scoria, excepting such small particles as had drifted from distant sources.

While not committing himself definitely to the theory of origin through impact of a gigantic meteorite, and while pointing out the seeming objections to such an hypothesis, the speaker showed that nevertheless no other conclusion seemed possible. Not merely had the borings in all cases reached a firm rock bottom, but the detritus thrown out, or now occupying the crater bottom, was wholly of the nature of the lime-and-sand stone (and its derivation products) forming the upper 800 feet of the strata.

The paper was illustrated by lantern slides.

At the 211th meeting of the society, held on December 9, 1908, Mr. F. E. Matthes presented the following paper: "The Glacial Character of the Yosemite Valley."

The glacial character of the Yosemite Valley is essentially a graded one—most pronounced at the upper end, gradually fading downvalleyward and ultimately vanishing at the lower end. This finds its explanation in the circumstance that the valley lay close to the periphery of the glaciated zone of the Sierra Nevada. Only the strongest glacial floods pushed any distance beyond the lower end of the valley. Most of the ice floods were of moderate volume and either barely reached its lower end or did not advance more than half way down the valley. The lower portion of the Yosemite has, therefore, been invaded by ice only at considerable intervals, and then by glacier ends mostly. Its glaciation has been feeble and stream erosion has ever had the upper hand in its fashioning. The upper half of the valley, on the contrary, has suffered frequent and relatively vigorous ice erosion and has consequently acquired a much more typical glacial aspect.

The gradation of the glacial character of the Yosemite is interrupted and obscured by a variety of aberrant sculptural features. These are explained by the selective action of the ice on rock-masses of widely different degrees of fissility. The granites of the Yosemite region are noted for their extreme and abrupt structural variations; they range in character from the schistose to the massive. The ice work in the valley was consequently subject to the controlling and directive influences of these exceptionally diverse structures. Again, the relative potency of these structural controls was the more marked because of the moderate size and disrupting power of the ice masses involved.

At the close of Mr. Matthes's address the sixteenth annual meeting of the society was held for the purpose of electing officers, and the following officers were elected for the ensuing year:

President—Mr. George Otis Smith.

Vice-presidents—Mr. M. R. Campbell and Mr. T. W. Stanton.

Secretaries—Messrs. Philip S. Smith and F. E. Matthes.

Treasurer—Mr. C. A. Fisher.

Members at Large of the Council—W. C. Mendenhall, Geo. W. Stose, Geo. H. Ashley, E. S. Bastin, L. C. Graton.

Ralph Arnold,
Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

The 187th regular and 25th annual meeting of the Washington Chemical Society was held at the Cosmos Club, Thursday evening, January 14, 1909. President Walker presided, and the attendance was 80.

Two papers were read, viz.:

"Technical Analysis of Water," by R. B. Dole, of the Geological Survey.

"Prevention of Dust on Highways," by Prevost Hubbard, of the Division of Public Roads.

The report of the secretary showed that 84 new names had been added to, and 42 names removed from the list of members during the past year. The membership of the society is now over 230. A proposed amendment to the by-laws, changing the time and manner of holding the election of officers, was submitted. The election of officers resulted as follows:

President—P. H. Walker.

First Vice-president—G. H. Failyer.

Second Vice-president—W. W. Skinner.

Secretary—J. A. LeClerc.

Treasurer—F. P. Dewey.

Extra Members of the Executive Committee—H. C. P. Weber, M. X. Sullivan, H. E. Patten, H. C. Gore.

J. A. LeClerc,
Secretary.

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 12, 1909

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

OPSONINS AND OTHER ANTIBODIES[1]

LOOKING back, we find that only fifty years ago the conception of the nature of the processes that run their courses in the animal body in infectious diseases, generally speaking, were hazy and still often even mystical. Preceded by occasional brilliant anticipations, notably by Bretonneau in regard to the specificness of infectious processes and by Henle with respect to the interaction between parasite and host, the tireless, unmeasurably fruitful investigation of the modern era, introduced by Pasteur and Koch, has brought to light not only the actual causes of many infectious diseases, but a great deal also in regard to the means and reactions in the infected body whereby they are overcome. Of these defensive processes phagocytosis and the action and formation of that remarkable group of bodies known as antibodies have received and still receive the greatest amount of attention. Indeed, the discovery of the wonderful power of the animal organism to respond to the effects of certain substances by the production of new antibodies must be reckoned as one of the great events, not only in medicine, but in general biology. We feel best acquainted with the antitoxins, the lysins, the agglutinins, the precipitins and the opsonins, but this does not exhaust the list, which is a growing one. The estab-

[1] Address of the vice-president and chairman of Section K—Physiology and Experimental Medicine, American Association for the Advancement of Science, Baltimore, 1908.

lishment of curative serum therapy by Behring when he demonstrated that antitoxic serum protects healthy animals against fatal doses of the corresponding toxin and may even cure the already sick, served to turn to the common good this innate faculty of the animal body to develop in so marvelous a manner its own resources.

Let it be noted once more that serum treatment, which has robbed diphtheria of its former terrors and the benefits of which are being extended to other diseases, is the direct outcome of scientific animal experimentation, and that without such experimentation it would not have been discovered and could not be maintained and extended.

The new methods and principles developed by the study of the animal reactions to infection did not long remain the exclusive property of the workshop of the bacteriologist. Ehrlich's side-chain theory of toxic and antitoxic action proved most heuristic, leading directly to fruitful investigation of other fields, and to-day biology, clinical and legal medicine, and physiological chemistry are using *immunological* methods to solve important problems.

According as stress was placed on the part of phagocytosis, on the one hand, and on the rôle of antibodies, antimicrobic as well as antitoxic, on the other hand, investigators until but recently were largely partisans of either the phagocytic or the humoral theory of healing and immunity. But the sharp antagonism between the adherents of these theories has subsided, because it has been made clear that neither mode of action is accomplished without the cooperation of cells and fluids. This is particularly true and easy of demonstration in the case of phagocytosis. Metchnikoff, the genial founder of the phagocytic theory, by broad comparative studies established the general occurrence and the significance in health and disease of phagocytosis in the higher as well as in the lower animals, and Denys and others have shown that the fluids of the blood play an essential part in the phagocytic process by so acting on microbes and other elements that they are made susceptible of phagocytic action. This property of the blood-fluid is now ascribed to definite substances, the opsonins of Wright and Douglas, and the tropins of Neufeld, both in all probability the same substances, and destined, I believe, to bear the name of opsonins, at least in the English language. While our acquaintance with the opsonins dates back only four or five years, they have been the subject of many researches, and much has been written about them, and it is to some more or less final results and certain general bearings of this work, fruit of the phagocytic theory as modified and perfected by the opsonic theory, that I wish to direct your attention.

It is generally accepted that phagocytosis of many bacteria—and also of red blood corpuscles, which are highly serviceable objects for the study of certain problems—is dependent upon substances—opsonins—which become attached to the bacterial cells or corpuscles, as the case may be, and so alter them that they are readily taken up by the leukocytes. The chief reasons for this conclusion are that leukocytes, carefully freed by repeated washing in salt solution, from the fluids in which they naturally exist, have but very little or no phagocytic power with respect to certain bacteria or corpuscles suspended in salt solution, while the same bacteria or corpuscles, after having been treated with suitable opsonic serum and then freed from the serum, are taken up by serum-free leukocytes. A few bacteria, however, *e. g.*, influenza bacilli, are readily phagocytable without the presence of opsonic serum.

Bacteria or corpuscles are not necessarily altered in opsonic serum and many bacteria, notably streptococci, pneumococci, anthrax bacilli, as well as others, grow freely in such serum. Heretofore the belief that phagocytes may cause destruction of bacteria rested largely upon more or less convincing morphological appearances. By means of the plate method for demonstrating bactericidal action it now has been shown conclusively that certain bacteria that do not suffer demonstrable injury by blood serum alone, such as those just mentioned, undergo intraphagocytic destruction when put into mixtures containing living leukocytes and opsonically active serum. In serum alone and in suspensions of serum-free leukocytes active growth occurs, but when the two are mixed destruction takes place, other factors being equal, in proportion to the number of leukocytes present. The actual demonstration of phagocytic annihilation of bacteria, formerly so often demanded by the opponents of the phagocytic theory, is here furnished.

The indications are that various opsonins with more or less well-marked specific affinities occur in all animals down to and including the echinoderms, being, like other antibodies, present to a variable extent in normal blood and other fluids.

In the course of his studies on lymph formation Professor Carlson[2] finds that opsonins and related bodies are more concentrated in the serum than in the lymph, that their concentration varies in the lymph from different organs, and that their apparent relative concentration in different lymphs also varies. The fact that the relative concentration is not the same in all lymphs speaks of course strongly in favor of the antibodies being distinct substances, a point concerning which there is still difference of opinion, some believing that it concerns different modes of action of the same body, others that each action is dependent upon a distinct body.

[2] Personal communication.

At first opsonins were regarded as substances of a relatively simple structure, quite easily destroyed by heat (60° C. for 15 to 30 minutes) and other agents. But it has been found that in most cases the total opsonic effect of fresh serum is the result of the combined action of two bodies, one relatively resistant to heat, the other easily destroyed by heat. The heat-resistant element is capable of opsonic action by itself and seems to unite quite firmly with the object upon which it acts; the opsonic effect as measured by the resulting phagocytosis is, however, greatly promoted on the addition of the other, thermolabile element, which alone has no opsonic power. In other words, opsonins, as a rule, seem to have the same duplex constitution as the lysins with which they are held by some to be identical.

The heat-resistant opsonic element appears to attach itself firmly to the bacterium or corpuscles upon which it acts because, in some instances at least, it is not detached even after many washings of the opsonified bacteria or corpuscle in large quantities of salt solution. Consequently opsonification is to be regarded as the special action of a distinct unit and not as the result of the influence of plasma or serum as a whole. The thermolabile, activating element, however, according to the results of recent experiments, probably remains free in the fluid of the phagocytic mixture, and there seems to me to be good room still for question as to whether its effect is exercised upon the phagocytable object or upon the phagocyte. Years ago Metchnikoff expressed the view that serum may stimulate leukocytes and other cells directly to phagocytosis, while, on the other hand, bacteria or red blood corpuscles that

take up what he and his followers then called "fixateur" thereby are made phagocytable. It is not impossible that further analysis of the mechanism of phagocytosis, under the guidance of the opsonic theory, will lead to this as the final result. At all events the failure to recognize the interaction of the two elements in the opsonic function of serum and the great difference in their combining properties is responsible for many of the divergent results of various investigators.

While normal blood contains only comparatively small amounts of heat-resistant opsonic substances, each unquestionably possessed of more or less well-marked specific affinities, the blood in conditions of acquired immunity may be richly charged with newly formed thermostable opsonic substances with marked specific affinity for the object against which the immunity is directed. Injections of suitable animals with bacteria or with alien red corpuscles cause specific opsonins to form; in human beings new opsonins arise as the result either of spontaneous infections or of the artificial introduction of killed bacteria and various bacterial products.

The opsonin content of the blood may be measured more or less accurately, either by means of the opsonic index or by determination of the highest dilution of the serum at which opsonic effect is still obtainable and comparing it with some normal standard. Speaking only in general terms, the opsonic index of Wright with respect to a given bacterium is obtained by comparing the number of bacteria taken up under the influence of the serum of the person or animal in question with the number taken up under the influence of the corresponding standard of normal serum under conditions that are as comparable as they possibly can be made.

By following the fluctuations of the opsonin content at frequent intervals important facts have been learned in regard to the laws of opsonin production. In the language of immunology any substance capable of giving rise to antibodies in suitable animals is called an antigen. Microbes and various microbic derivatives, cells, red corpuscles and serum may contain several antigens and incite the formation of more than one kind of antibody so far as indicated by the usual modes of antibody effect. Thus the proper single injection in a suitable animal of typhoid bacilli or of alien red cells is followed usually by the appearance in the blood of increased amounts of lysins (lytic amboceptors), agglutinins and opsonins for the particular cells injected. Usually all three of the bodies mentioned are not increased in the same proportions so far as determinable by our present methods of measurement, but they all commonly follow the same general course, which seems to hold good for antibodies in general: For the first day or two or three there is often, but apparently not always, a fall below normal in the amount of the specific antibodies in the serum; this period is called the negative phase and is succeeded by a steady rise above the normal, which, as a general rule, reaches its maximum about the eighth to twelfth day when there is a fall, the apex of the curve being sometimes quite sharp, at other times more rounded, and then begins a gradual return to the normal.

It is important to note that the fall below normal, the negative phase, is specific, that is, affects only the normal opsonin, and by inference the other antibodies, for the particular bacterium or corpuscles injected, a clear indication, it strikes me, that there are several normal antibodies, each with specific affinities and probably not different from the corresponding body formed when the machinery of immuniza-

tion is set in motion. The cause of this interesting negative phase is not well understood, but it lies closely at hand to ascribe it to neutralization of the normal antibodies by the antigen, or to its effect on the antibody-forming cells. There is good reason to believe, especially on clinical grounds, that the general resistance to the specific infection is lowered in the negative phase, although certain experimental results indicate that the opposite may be the case.

Blood serum may contain antigens causing the production of antibodies for its homologous corpuscles; thus, the injection of antidiphtheric horse serum is followed by a wave-like rise and fall of the lysin, agglutinin and opsonin for horse corpuscles in the blood of the patient, the highest point being reached usually about the tenth day. Undoubtedly these antigenic substances are derived from disintegration of the corpuscles.

Serum and other protein mixtures also induce the formation of specific precipitating substances in suitable animals. Whether the specific precipitin test for protein material, now extensively used for the identification of blood and in the solution of allied problems, will prove of service also in the study of pure proteins, remains to be seen.

In several acute infectious diseases the course of the formation of new opsonin for the infecting agent, in the typical attack, terminating promptly in recovery without complications, shows a marked general resemblance to the opsonin or antibody curve after a single antigen injection in the normal animal. It also bears definite and constant relations to the clinical phenomena. During the early stages when the symptoms are pronounced there is a negative phase, and then as the symptoms begin to subside the opsonin curve rises above normal, reaching the highest point several days after the onset, followed by a gradual subsidence. This is true of the pneumococcus opsonin in pneumonia, of the opsonin for the diphtheria bacillus in diphtheria, of the streptococcus opsonin in erysipelas, and also of the opsonin for the diplococcus of mumps in that disease. The curve is typical as well for the streptococcus in scarlet fever, indicating clearly that this organism unquestionably plays a definite rôle in scarlet fever whatever its actual causative relation to the disease may be. In pneumonia the greatest rise in the leukocytosis appears to precede somewhat the highest rise of the opsonin. In all these diseases the typical wave-like opsonin curve is modified by the development of complications of various kinds and at the onset of which it commonly undergoes a distinct depression. In rapidly fatal cases, for instance of pneumonia, the opsonic curve or index may not return from the primary depression but sink lower and lower. In prolonged infections, general as well as local, there occur irregular fluctuations and in chronic, more or less stationary cases, the opsonic index is often subnormal. At this time further details can not be given. My chief point is to make clear the close association between recovery and the wave-like rise of the opsonin and, as a result of the immunization, in all likelihood also of other antibodies in the typical attack of acute so-called self-limited infections. In some of the diseases the opsonin is the only antibody that we can measure readily with our present means. As I have stated, intraphagocytic destruction of pneumococci and streptococci takes place in the presence of fresh leukocytes and opsonic serum, whereas either alone constitutes a good medium for these bacteria. Taking these facts into account, it seems to me that the wave-like course of the opsonin in pneumonia and in acute streptococcus infec-

tions is a strong point on the side of the importance of phagocytosis in their healing, whatever other measures, of which at present we know less or nothing, may be in operation also.

Whether the opsonic action of serum is caused by distinct and independent substances or by antibodies with other actions as well, has been an interesting question concerning which there is still difference of opinion. The question now seems to be narrowed down to whether the opsonins and lysins are the same, some claiming that opsonification merely is the result of an early stage of lysis before actual solution takes place. Opsonins would appear to be distinct from other antibodies because a given serum may be opsonic, but not lytic, while the reverse probably also occurs. But here certain difficulties arise. While it is well established that serum may be strongly opsonic without being lytic and without even containing lytic amboceptor so far as our present methods indicate, the suggestion is made that in such cases the failure to obtain lysis may be owing to the state of the object tested and not to the absence of lysins. This consideration applies with most effect to instances in which we know the bacterium or corpuscle is susceptible both to lysis and to opsonification, and in which lysis might not take place either because the serum was not active enough or because of some special resistance to lysis. The explanation falls short, however, when applied to bacteria like pneumococci and streptococci, which, while readily opsonified, are yet insusceptible to lysis. In this case the claim that lysis does not take place because of the physical state of the bacteria is merely an assumption.

If opsonification and lysis depend upon the same body the opsonic and lytic powers of the serum of an animal in the course of immunization should always run parallel. If they do so that fact does not of itself prove that it concerns one body, but failure to run parallel would indicate the existence of separate bodies with different functions. Actual observations show that in certain animals single injections of alien red corpuscles may increase the opsonic power of the serum for that corpuscle a hundred times or more above normal, while the lytic power for the same corpuscle may be increased comparatively much less and in some conditions not at all. On this account, then, as well as for other reasons, the view that opsonins, meaning thereby the thermostable opsonic substances, constitute a distinct class of antibodies, seems to me to be correct.

That the activating or complementing opsonic substance is closely related to the complement of lysis is indicated by a number of considerations: Both are sensitive to the action of heat, being destroyed by an exposure of thirty minutes to 58–60° C.; both appear to be split up into two distinct components by water, and both are neutralized by a number of ionizable salts. As stated before, the opsonic complement, however, seems to remain free in the phagocytic mixtures, whereas the complement of lysis is regarded generally as bound by the amboceptor.

We come now to a most interesting part of our subject, namely, the resistance offered by microbes under different conditions to antibodies and more particularly to opsonins.

Since the discovery of the chronic microbe carrier the adaptation of microbes to the defensive mechanisms of the animal body is no longer merely of academic interest. Under the conception that phagocytosis and bacteriolysis form the basis of healing and immunity in perhaps most of the infectious diseases, the infecting microbes should disappear at the time of recovery. This is probably the general rule,

but there are many striking exceptions illustrated well by the now familiar "*bacillus carrier.*" The body may overcome the disease but not the cause, which may persist in spite of the increase in antibodies. The disease subsides, the disturbances are smoothed away, and yet the germ lives on in the host, apparently harmless and unharmed, sometimes for remarkably long periods. But the equilibrium is not always a stable one; the immunity of the host may give way and recurrence develop; or the resistance of the germ may weaken and eventually complete destruction and final elimination take place.

Germs isolated from typhoid and cholera carriers have been found in some cases to offer special resistance to antibodies, including opsonins, but the mechanisms of this mutual immunization of microbe and host are still obscure, and on account of the self-evident and tremendous importance of the carrier in spreading disease they invite special study.

At this point I may recall that the relapses in relapsing and related fevers are now ascribed to the survival in each attack of a few spirilla which, having become immune to the antibodies of the host, give origin to new "serum-fast" strains that continue the relapses.

Exceedingly interesting conditions are found in certain chronic infections of the urinary tract with bacilli of the colon group, the indications being that the infecting bacillus may partially immunize itself, in one case to the lysin, in another to the opsonin, in the patient's blood, or that the amounts of different antibodies vary greatly in the different cases.

In Metchnikoff's original doctrine of phagocytosis in infectious diseases a fundamental tenet reads that as a microbe grows in virulence its resistance to phagocytosis increases. Recent experiments give results in complete harmony with this teaching. On analysis the resistance of certain highly virulent bacteria to phagocytosis is found to depend on insusceptibility to opsonic action, owing apparently to lack of affinity for the opsonin. As pneumococci, streptococci and other bacteria on successive passages through suitable animals become more and more virulent for these animals, they at the same time acquire a parallel increase in resistance to phagocytosis. When cultivated outside the body reversion readily takes place to less virulent states, associated with a returning affinity for opsonin and an increasing susceptibility to opsonic action. Investigating this property of pneumococci to develop such strong defense against phagocytosis, Rosenow found that extraction or autolysis of virulent pneumococci brings into solution a substance or group of substances that neutralize the pneumococco-opsonin in human serum, but not other opsonins. After extraction of this substance, which is thermostable and insoluble in alcohol or ether, virulent pneumococci unite with opsonin and become phagocytable, while avirulent pneumococci on treatment with extracts of virulent strains not only become resistant to phagocytosis in the test-tube, but also to some degree virulent for animals.

Entirely independently, Tchistovitch and Yourevitch appear to have reached identical results on all points, except that they did not study the virulence of avirulent pneumococci after treatment with extracts of virulent strains.

We may say then that the properties called *virulence* in pneumococci appear to depend, to a very large extent, if not wholly, on the formation of an actual substance—"virulin"[3]—which may be extracted and studied by itself. It is hoped that this demonstration may prove a basis

[3] "Antiphagin"—Tchistovitch and Yourevitch.

of departure for new and fruitful work in pneumococcus and similar infections.

LUDVIG HEKTOEN
MEMORIAL INSTITUTE FOR
INFECTIOUS DISEASES,
CHICAGO

THE FIRST ANNUAL CONFERENCE OF THE GOVERNORS IN NEW ENGLAND

IN these days of conventions and association gatherings, it is difficult to select one on the grounds of special importance or significance. Among those which I have had the privilege of attending in recent years, the conference held in Boston, November 23 and 24, easily surpassed all others of material import when measured by the importance of the subjects considered and the vast possibility of bettering existing conditions. This was the first annual conference of the Governors of the New England states, called for the purpose of considering certain natural industries and utilities common to all, and legislation affecting them.

The conference was presided over by Governor Curtis Guild, Jr., of Massachusetts, and attended by every governor in office and governor-elect with one exception, namely, Governor Higgins, of Connecticut, "who had married a wife and therefore could not come."

Subjects Considered.—There were three sessions, and each session was devoted to the consideration of one subject, or a correlated group of subjects. The first session was devoted to tree planting interests, and this was divided into two parts: (1) Forest trees and (2) orchard trees.

The forest-tree side was discussed by Mr. Gifford Pinchot, United States forester, who showed impressively how rapidly the forest supplies of the country were decreasing; how vast areas of lands in New England, of little or no value for farming, might be utilized; the profitableness of forests as a commercial enterprise; and then finally urged the passage of uniform legislation in New England providing adequate protection of forest lands against fires. This subject aroused a lively discussion, and drew attention to the reasonable opportunities for safe investment of capital.

Orchard Trees.—The planting of apple trees on the hilly lands in New England, not in the valley farming lands, was urged by the professor of horticulture of Cornell University. He did this on the ground that New England was the natural home of the apple in the United States, for it was here that the leading commercial varieties of to-day originated; that the land was cheap, that labor was abundant, and markets both foreign and domestic convenient. Moreover, the quality of the New England apple was unsurpassed by that produced in any other section. The demand was keen, and for fruit of fine quality New England markets were the best in the country.

What was needed to improve the situation was reorganization of ideas and practises in relation to orcharding. The slipshod methods of generations and the opening of new irrigated fruit lands in the west discouraged on the one hand the would-be planter, and on the other attracted his attention to the opportunities in distant lands. What in his opinion was now needed was the redirection of capital to apple-growing as a staple and safe industry. We should have illustration orchards, planted and conducted either by men of faith in the business with sufficient capital to back up the enterprise, or by the state governments themselves. Such work should be conducted with the energy characterizing western enterprises, and guided by intelligence and up-to-date methods. Certain legislation was required in order to secure a uniform grade, uniform methods of packing, and certain standard packages.

The second session of the conference was devoted to a consideration of the fast-disappearing lobster and the much-preyed-upon mollusks.

These subjects were discussed by experts and aroused much interest. They proved their contention that these staple sea foods were in a fair way to be exterminated within a measurable length of time, and that without intelligent protection a great natural re-

source of most of the New England states would disappear.

Highways.—The highway problem, of course, aroused an interesting discussion, for here the advocates of the purely utilitarian met the devotees of pleasure on a common ground. Methods of constructing highways, the repair of highways and the influence of the automobile on the life of the highway, were live issues of this general topic. The necessity of constructing trunk lines whereby the leading centers of New England should be directly connected, and the necessity of providing for adequate maintenance, suggested the desirability of cooperation in the prosecution of these purely interstate projects.

The conference was made up then of these three sessions, crowded full of features of interest. In addition to the eleven governors, a number of invited delegates representing the topics mentioned above were present, and were allowed the courtesy of the floor for their periods.

Mr. F. L. Dean, secretary to Governor Guild, acted as executive secretary of the conference and will have charge of printing the report of the proceedings.

A feature of the conference was the masterly, and one might say artistic, way in which the speakers were introduced and the discussion expanded, or repressed as occasion seemed to demand, by the versatile chairman, Governor Guild, of Massachusetts. Undoubtedly the first of a great series of conferences, whereby questions of common import to the New England states shall be considered impartially and uncolored by political surroundings, has been launched, and unquestionably it will be followed by others even more influential in character.

John Craig

DR. GIUSEPPE NOBILI

Professor Lorenzo Camerano in the *Bollettino dei Musei di Zoologia ed Anatomia comparata della R. Università di Torino*, Vol. XXIII., number 595, announces the death of Dr. Giuseppe Nobili on the fourth of December, 1908, at Omegna, Italy. He was the son of Dr. Gaudenzio and Adele Antonioli Nobili and was born at Omegna, February 11, 1877. He received his doctor's degree in natural science at the Royal University of Turin in 1899, becoming also an assistant in the Zoological Museum of that University, and later (1903) was made an assistant in the Museum of Comparative Anatomy.

While a student at the university he engaged in some botanical researches and published several interesting notes. He soon, however, turned his attention to zoology and as early as 1896 wrote a paper on the decapod crustaceans collected by Dr. A. Borelli in the Argentine Republic and Paraguay. This was the first of a long series of publications chiefly on Crustacea (Decapoda, Stomatopoda, Isopoda, etc.) based on collections in the museum at Turin, and also in those at Geneva, Genoa, Naples, Paris, Budapest and Madrid. These papers (53 titles in all) contain descriptions of many new genera and species and critical discussions of others, and form an important contribution to our knowledge of the Crustacea. Foremost among them is his monographic work on the decapods and stomatopods of the Red Sea, published in the *Annales des Sciences Naturelles* (9), IV., 1906. Professor Camerano pays a high tribute to the personal character of Dr. Nobili, who, by his unwearying activity, had built up the collections in the Turin Museum, and by his kindness of heart had won the affection and esteem of his associates.

DARWIN ANNIVERSARY ADDRESSES AT THE UNIVERSITY OF CHICAGO

The Biological Club of the University of Chicago has arranged the following program:

February 1—Introductory remarks by President H. P. Judson.

"The World's Debt to Darwin," Professor E. G. Conklin, Princeton University.

February 2—"The World of Thought Before and After the Publication of the Origin of Species," Professor G. H. Mead.

February 4—"Cosmic Evolution," Professor F. R. Moulton.

February 9—"Bridging the Gap between Living and Lifeless," Professor A. P. Mathews.

February 10—"Phylogeny," Professor S. W. Williston.

February 17—"Variation and Heredity," Professor W. L. Tower.

February 18—"The Interpretation of Environment," Professor H. C. Cowles.

February 24—"Darwinism and Political Science," Professor C. E. Merriam.

February 25—"Human Evolution—Physical and Social," Dr. Geo. A. Dorsey.

March 3—"The Influence of Darwinism on Psychology," Professor J. R. Angell.

March 4—"The Theory of Individual Development," Professor F. R. Lillie.

March 10—"The Evolution of Religion," Professor Shailer Mathews.

March 11—"Darwinism and Experimental Methods in Botany," Professor D. T. MacDougal, Carnegie Institute.

March 17—"Evolution in Language and in the Study of Language," Professor C. D. Buck.

March 18—"Selection Mutation and Orthogenesis," Professor C. O. Whitman.

SCIENTIFIC NOTES AND NEWS

DR. JAMES B. ANGELL proposes to present his resignation as president of the University of Michigan on February 17. It is understood that the office of chancellor will be created and that he will be the first to occupy this position.

DR. WILHELM TRABERT, professor of cosmical physics at Innsbruck, has been appointed director of the Austrian Bureau of meteorology and geodynamics, vacant by the death of Professor Pernter.

DR. FRANK WIGGLESWORTH CLARKE, chemist, U. S. Geological Survey, and professor of mineral chemistry in the George Washington University, has been invited by the Chemical Society of London to deliver a memorial lecture on Dr. Wolcott Gibbs. As Professor Clarke is to attend the International Congress of Applied Chemistry, which meets in London on May 27, this lecture will follow shortly after the adjournment of the congress.

THE Academy of Natural Sciences of Philadelphia has elected as correspondents the following: Dr. Albert Calmette, of Lille; Dr. Sven Hedin, of Stockholm; Dr. Robert F. Scharff, of Dublin, and Dr. John M. Clarke, of Albany.

SIR JAMES DEWAR and Dr. Ludwig Mond have been elected honorary members of the German Chemical Society.

M. P. VILLARD has been elected a member of the Paris Academy of Sciences in the Section of Physics to succeed M. Mascart.

ON the recommendation of a committee of the Royal Society of Arts and the Royal College of Physicians, the Swiney prize, of the value of $1,000, has been awarded to Dr. C. A. Mercier, for his work on "Criminal Responsibility."

A NEW portrait of President Eliot, of Harvard University, by Mr. Charles Hopkinson has been hung in the Harvard Union, where it will remain for the next few days. The portrait represents President Eliot seated at his desk.

MR. H. F. NEWALL, assistant director of the Observatory, Cambridge, has been elected a fellow of Trinity College.

WE regret to learn that the illness of Professor G. D. Louderback, of the department of geology of the University of California, has made it necessary for him to take an indefinite leave of absence.

PROFESSOR F. W. BLACKMAR, head of the department of sociology in the University of Kansas, who has spent four summers in investigating the chief irrigating plants in western states, has finished a report on the development of irrigation and the reclamation service of the government in the arid west. This report will be published by the Carnegie Institution of Washington.

PROFESSOR TREVOR KINCAID, of the department of zoology, University of Washington, will leave Seattle about the first of April for Simferopol, Crimea, Russia, where he will undertake, for the U. S. Bureau of Entomology, the collection and shipment of parasites of the Gypsy moth. During the absence of Professor Kincaid, Professor A. D. Howard, Ph.D. (Harvard), formerly of Westminster College, Pennsylvania, will have charge of the department.

Mr. L. F. Noble, graduate student in geology at Yale University, has returned from a six-months' trip in the Lower Colorado Canyon, where he has been pursuing studies in structural geology, particularly with reference to the Algonkian.

Nature states that Professor E. A. Minchin has left England for three months, accompanied by his assistant, Dr. Woodcock, on a visit to the zoological station at Rovigno, in order to carry on researches on the development of the trypanosome of the little owl (*Athene noctua*).

Dr. Charles William Andrews, F.R.S., assistant in the Geological Department of the Natural History Museum, London, has returned from Christmas Island, in the Indian Ocean, where he has been making scientific researches.

Dr. Sven Hedin delivered at Stockholm on January 22 a lecture upon his travels in Central Asia before a large audience, which included King Gustav and the royal family, and the members of the Anthropological and Geographical Societies. The Wahlburg medal of the latter society has been conferred on Dr. Sven Hedin, and the society has raised a fund of over $2,500 to be known by the explorer's name, which will be devoted to geographical research.

Professor A. G. Webster, of the department of physics at Clark University, is giving three lectures under the auspices of the Sigma Xi Society at each of the universities of Missouri, Kansas, Nebraska and Iowa, and one each at Wisconsin and Northwestern, speaking on the present outlook in physics and on his researches in acoustics.

Dr. R. S. Woodward, president of the Carnegie Institution of Washington, lectured to the students of the University of Wisconsin on the evening of February 2 on the work of that institution.

Dr. Wm. A. Noyes, professor of chemistry in the University of Illinois and editor of the *Journal of the American Chemical Society*, delivered an address before the Saint Louis Chemical Society, on January 29, on "Lavoisier." After the meeting an informal dinner was held in honor of the speaker.

Professor Wm. J. Gies, of the department of biological chemistry of Columbia University, is conducting a course of public lectures on "The Chemistry of Digestion" on Monday evenings at Cooper Union. The lectures are illustrated by zoetrope figures, and by chemical and digestive demonstrations.

Sigma Xi lectures at the University of California have been given as follows: "The Effect of Solutions on Plant Growth," by Professor W. J. V. Osterhout; "Some Recent Discoveries in Solar Physics," by Professor E. P. Lewis; "The Origin and Distribution of Shell Mounds in the San Francisco Bay Region," by Mr. N. C. Nelson.

At the meeting of the American Nature-study Society held at Baltimore the following officers were elected for 1909: *President*, Professor C. F. Hodge, of Clark University, Worcester, Mass. *Vice-presidents*—Professor V. L. Kellogg, of Stanford University, Cal.; Professor F. L. Stevens, North Carolina College of Agriculture and Mechanic Arts, Raleigh, N. C.; Professor W. Lochhead, Macdonald College, Quebec; Professor O. W. Caldwell, The University of Chicago; Professor B. M. Davis, Miami University, Oxford, O. *Directors* (for two years)—G. H. Trafton, Public Schools, Passaic, N. J.; Professor F. L. Holtz, Brooklyn Training School, N. Y.; Professor J. Dearness, Normal School, London, Canada; Mrs. Anna Botsford Comstock, Cornell University, Ithaca, N. Y., and Dr. Ruth Marshall, Milwaukee High Schools. Directors D. J. Crosby, C. R. Mann, S. Coulter, H. W. Fairbanks and M. F. Guyer and Secretary M. A. Bigelow were elected in 1908 to serve two years.

A Science Club has been organized among the members of the agricultural department of Delaware College and the Agricultural Experiment Station staff. The following officers were elected: *President*, Professor C. A McCue; *Vice-president*, Professor C. O. Houghton; *Secretary*, Professor A. E. Grantham. Weekly meetings will be held.

THE executive council of the British Science Guild has considered the matter of naming London streets after distinguished men of science. The members of the executive committee were requested to send in names which were reduced to the following thirty-one: Newton, Darwin, Harvey, Jenner, Huxley, James Watt, Gilbert, Kelvin, Faraday, Joule, Clerk Maxwell, Stokes, Tyndall, Captain Cook, Livingstone, Franklin, Ross, Bruce, Mungo Park, Cavendish, Dalton, Priestley, Boyle, Andrews, Halley, Herschel, Horrocks, Adams, Bradley, Howard, Piddington.

AT the meeting of the American Philosophical Society, on February 5, Professor E. G. Conklin, of Princeton University, offered a minute in commemoration of the centenary of the birth of Charles Darwin.

THE Botanical Society of Pennsylvania has arranged a special meeting to commemorate the one hundredth anniversary of Darwin's birth and the fiftieth anniversary of the publication of the "Origin of Species." This will be held on Friday evening, February 12, in Biological Hall, University of Pennsylvania. The program consists of "A Short Sketch of Darwin's Life," by Dr. Henry Leffman; "Pre-Darwinian Theories of Plant Life," by Dr. Louis Krautter; "Darwin's Contribution to Botany," by Dr. J. W. Harshberger; and "Present Day Views on Organic Evolution," by Dr. C. H. Shaw.

THE deaths are announced of Dr. Hermann Minkowski, professor of mathematics at Göttingen, and Dr. Otto Rupp, professor of geometry at Brünn.

THE U. S. Civil Service Commission announces an examination on February 24, to fill a vacancy in the position of scientific assistant, $720 per annum, in the Bureau of Fisheries, and vacancies requiring similar qualifications as they may occur.

THE next meeting of the Physical Society will be held at Columbia University, New York, on Saturday, February 27.

PROFESSOR W. A. SETCHELL has made a gift to the University of California of his herbarium, consisting of 15,468 specimens of algæ.

NUMEROUS requests are received by the Geological Survey from educators, publishers and lecturers for photographs and lantern slides, in most cases those desiring them being willing to defray the expense of making the prints or slides, but there is at present no provision of law under which they can be furnished by sale. Some of these views taken by members of the survey have been used in a limited way by the survey in its publications; but many of these are out of print, leaving the photographic negatives to a large extent an unused resource of the public—data belonging to the public, but not available to it. If response could be made by the survey to the demands for prints from such negatives it would be in the interest of education and the dissemination of knowledge; and the survey being willing to supply reproductions from its great collection of photographic material, Senator Flint, of California, has introduced a proposed amendment to the civil service bill which reads as follows:

That the director of the Geological Survey shall hereafter furnish to any person, concern, or institution, in the interest of education and the dissemination of knowledge, that shall pay in advance the whole cost of material and services thereof, copies of any photographs or lantern slides in the possession of the United States Geological Survey; and the moneys received by the director for the same shall be deposited in the United States Treasury to the credit of the appropriation "Geological maps of the United States" of the said Geological Survey, and this provision shall become effective immediately.

A BILL to establish a bureau in the Department of the Interior to be known as the Children's Bureau, has been introduced in the House of Representatives. It reads as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there shall be established in the Department of the Interior a bureau to be known as the Children's Bureau.

SEC. 2. That the said bureau shall be under the direction of a chief, to be appointed by the President, by and with the advice and consent of the Senate, and who shall receive an annual compensation of five thousand dollars. The said bureau shall investigate and report upon all mat-

ters pertaining to the welfare of children and child life, and shall especially investigate the questions of infant mortality, the birth rate, physical degeneracy, orphanage, juvenile delinquency and juvenile courts, desertion and illegitimacy, dangerous occupations, accidents and diseases of children of the working classes, employment, legislation affecting children in the several states and territories, and such other facts as have a bearing upon the health, efficiency, character and training of children. The chief of said bureau shall, from time to time, publish the results of these investigations.

SEC. 3. That there shall be in said bureau, until otherwise provided for by law, an assistant chief, to be appointed by the Secretary of the Interior, who shall receive an annual compensation of three thousand dollars; one private secretary to the chief of the bureau, who shall receive an annual compensation of one thousand five hundred dollars; a chief clerk, who shall receive an annual compensation of two thousand dollars; one statistical expert, at two thousand dollars; four clerks of class four; four clerks of class three; two clerks of class two, and six clerks of class one; five clerks, at one thousand dollars each; two copyists, at nine hundred dollars each; one messenger, at seven hundred and twenty dollars; two special agents, at one thousand four hundred dollars each, and two special agents, at one thousand two hundred dollars each.

SEC. 4. That the Secretary of the Interior is hereby directed to furnish sufficient quarters for the work of this bureau at an annual rental not to exceed two thousand dollars.

SEC. 5. That this act shall take effect and be in force from and after its passage.

COLUMBIA UNIVERSITY has arranged a series of free public lectures on Sanitary Science and Public Health which will be given in the large lecture room of the College of Physicians and Surgeons, No. 437 West 59th Street, on Mondays and Wednesdays during February, March and April. They will begin each day at 5 P.M., and the doors will be closed ten minutes later. The first lecture, "The Rise and Significance of the Public Health Movement," by William Thompson Sedgwick, professor of biology at the Massachusetts Institute of Technology, was given on February 1. Among the other lecturers and their subjects will be Professor Adami, of McGill University, "The Great Pathological Discoveries and their Bearing upon Public Health Problems"; Professor Burr, of Columbia University, "Water Supplies and Sewage Disposal"; "Public Health Problems of the Municipality, State and Nation," by Thomas Darlington, Health Commissioner of this city; Walter Bensel, Sanitary Superintendent; Eugene H. Porter, State Health Commissioner, and Walter Wyman, Surgeon General, Public Health and Marine Hospital Service of the United States; H. M. Biggs, Chief Medical Officer of the New York Health Department, on "The Prevention of Tuberculosis," and Professor Theobold Smith, on "Diseases of Animals Transmissible to Man."

THE Cancer Commission of Harvard University announces a course of lectures on "Tumors," to be given on Thursday afternoons, at 5 o'clock, in the medical school. The lectures will be open to members of the university and to physicians. The dates and titles follow:

February 4—"The Bearing of the Experimental Investigation of Tumors on the Tumor Problem in General," by Dr. E. E. Tyzzer, Boston.

February 11—"The Regulatory Processes of Tumor Cells," by Dr. W. T. Howard, Cleveland, O.

February 18—"The Classification of Tumors," by F. B. Mallory, Boston.

February 25—"The Physiological Pathology of Intracranial Tumors," by Dr. Harvey Cushing, Baltimore, Md.

March 4—"The Etiology of Tumors considered from our Knowledge of Congenital Tumors and Tumors following Repeated Injury," by Dr. S. B. Wolbach, Albany, N. Y.

March 11—"The Problem of Cancer considered from the Standpoint of Immunity," by Dr. F. P. Gay, Boston.

PROFESSOR W. W. CAMPBELL, director of the Lick Observatory, writes that Volume VIII. of the publications of the observatory, now issuing from the bindery of the State Printing Office, Sacramento, contains heliogravure reproductions of the late Director Keeler's photographs of nebulæ and star clusters made with the Crossley reflector. Other contents are a description of the Crossley reflecting telescope by Director Keeler, a list of the nebulæ and clusters photographed, a catalogue of 744 new

nebulæ discovered on the negatives, and new determinations of the positions of the nebulæ previously known in the regions of the sky covered. It is hoped that the regular correspondents of the Lick Observatory can be supplied promptly with copies. The cost of the volume has been unusually high on account of the expensive processes and materials employed. There are 71 full-page heliogravure reproductions, printed by hand press on suitable paper.

The Cleveland Chemical Society has organized itself into a local section of the American Chemical Society with the following officers: *President,* Franklin T. Jones; *Secretary,* Sherley P. Newton; *Board of Managers,* H. V. Arny, W. R. Veazey, president and secretary *ex-officio; Councilor,* C. F. Mabery. A charter has also been granted for the formation of a section of the American Chemical Society comprising the western portion of the state of Washington with headquarters at Seattle.

At the recent meeting of the Southern Society for Philosophy and Psychology, held at the Johns Hopkins University, Baltimore, Md., the following officers were elected for 1909: *President,* Professor Albert Lefevre, University of Virginia; *Vice-president,* Dr. Shepherd Ivory Franz, Government Hospital for the Insane, Washington, D. C.; *Secretary-treasurer,* Professor Edward Franklin Buchner, Johns Hopkins University. To serve three years as members of the council: Professor James Franklin Messenger, State Normal School, Farmville, Va.; Professor Robert Morris Ogden, University of Tennessee. Other members of the council are: Dr. William Torrey Harris, Washington, D. C.; President D. B. Purinton, West Virginia University; Professor James Mark Baldwin, Johns Hopkins University; Principal Reuben Post Halleck, Louisville, Ky.

UNIVERSITY AND EDUCATIONAL NEWS

Mrs. Esther Gowen Hood has given the University of Pennsylvania $100,000 to establish graduate fellowships in the law department. The gift is a memorial to her father, the late Franklin B. Gowen.

Mr. Adolphus Busch, who last August promised to contribute $50,000 towards the $300,000 necessary for the erection of the new building for the Germanic Museum at Harvard University, has increased his gift to $100,000.

The General Education Board has offered to give Bryn Mawr College $250,000 on condition that friends of the college subscribe $280,000 by June, 1910. This is in addition to the $100,000 recently given by the alumnæ. Of this sum $130,000 is to be used to pay the debt of the college, and the balance is to be reserved as an endowment fund.

The building for the new California Museum of Vertebrate Zoology, at the University of California, is now under construction. Its cost, which is to be about $14,000, is to be met in part by the regents' appropriation of $7,000, and in part by an arrangement with Miss Annie Alexander, the patron of this new department, whereby she adds $7,000 with the provision that her annual grant for maintenance for the next seven years shall be $6,000 instead of $7,000, as at first proposed by her.

The regents of the University of Colorado have authorized the establishment of a summer laboratory for botany and zoology at Tolland, Colo., altitude 8,889 feet. The laboratory will be in charge of the regular instructing staff of the university, and there will be courses in elementary biology, plant anatomy, plant taxonomy and ecology. The location of the laboratory is such that students can study the plants and animals of all the different life zones from plains to alpine heights. Work done at the laboratory will count toward a degree in the university.

Dr. Fairbairn, who will retire from the principalship of Mansfield College, Oxford, at Easter, has given to the college his valuable theological and philosophical library.

Dr. E. A. Noble was installed as president of the Woman's College of Baltimore on February 2, when addresses were delivered by

President Noble, Dr. H. S. Pritchett, president of the Carnegie Foundation for the Advancement of Teaching; Dr. Elmer E. Brown, U. S. commissioner of education; Dr. Ira Remsen, president of the Johns Hopkins University and Mr. John E. Semmes, president of the Baltimore school commissioners.

DR. FRANK L. MCVEY has been elected president of the University of North Dakota. He was formerly professor of economics at the University of Minnesota and is now chairman to the tax commission of the state.

THE trustees of Columbia University have appointed Dr. William G. MacCallum, professor of pathological physiology in the Johns Hopkins University, to be professor of pathology in succession to Dr. T. Mitchell Prudden, who will retire from active service on July 1 next. At the same time the trustees have made provision for the development and extension of the departments of bacteriology under professor Philip H. Hiss, Jr., and of clinical pathology under Professor Francis C. Wood. Increased attention will be paid by these departments to the needs of advanced students and investigators.

AT the College of the City of New York, Dayton J. Edwards has been appointed tutor in natural history. He is a graduate of the University of Maine, and has lately been an assistant at Columbia University.

MR. G. H. Cox has been appointed instructor at the University of California in geology and mineralogy.

DISCUSSION AND CORRESPONDENCE

EDUCATION AND THE TRADES

TO THE EDITOR OF SCIENCE: In your issue for November 14 Mr. William Kent asks a question which interests me greatly and which, although I can not answer, I believe I can lay down the lines along which the answer must be made.

In the first place, I wish to express my unqualified approval of the letter of Stella V. Kellerman in your issue of November 13, with which Mr. Kent expresses agreement, but which causes him to ask the question referred to. Latin, Greek and the mathematics have been taught for so many centuries that we have learned how to get out of them the highest possible degree of pedagogic value. This merely means that we have learned how, by means of studies of this character, to get hard work out of the student, while at the same time we maintain his interest. I assume that the pedagogic value of a study is largely comprehended in the possibility of teaching in the manner above mentioned. A great many people who honestly believe that our system of education should take more account of the daily affairs of life fear that when we replace any of the old studies by new ones which relate to modern industries, the work of the schools will lose its pedagogic value. Speaking in a general way, I believe this will be true, but this is not because the new studies do not have this value in them, but because we have not yet learned how to get it out of them. I believe there are some things which have higher pedagogic value than anything taught in our schools to-day, else why is it that with only 29 per cent. of our population actually living on the farm, with miserably poor school facilities as compared with our city population, this 29 per cent. furnishes about 70 per cent. of the leaders in every phase of activity in this country?

The point I wish to make is further illustrated by an instance that occurred in connection with the school garden work in Washington city schools. The teacher in charge had found difficulty in getting boys twelve to fifteen years old to lay off the plats properly. Two little boys, six and eight years old, from the hills of Virginia, came into school, never having seen plats laid off, but it was found that even the younger of these, if put in charge of a squad of boys twice his age, would have the work done according to directions. This greatly puzzled the teacher, and she asked me to explain it. I gave as an explanation the fact that these two small boys had enjoyed better pedagogical advantages than the others. But the teacher thought this im-

possible, as the smaller one had been to school only one year, and that in a little log cabin up in the hills. But when I called her attention to the fact that these boys had lived on a farm where they had been taught to assume responsibility and to do things, she agreed with my explanation.

I believe that it is the pedagogical value of farm work and the chance of placing responsibility on the child that has more than anything else to do with the development of efficiency and character in farm children, and this accounts for the fact that 29 per cent. of our population on the farms furnishes 70 per cent. of the efficient men in this country.

We have much yet to do before we understand the whole of this question. I believe, however, it is possible to outline a course which shall deal directly with the industries of our people and which will not only better fit pupils for their life's work, but will even fit them for college better than the best of our present high schools. We all recognize that because of our ignorance of the real principles involved in training the young mind, a lot of experimenting must be done before we have arrived at a final solution of this important question. The criticism I have to make of our school system is that we have neglected these essential experiments. It is high time that earnest effort be made in this direction.

W. J. Spillman

U. S. Department of Agriculture

THE SIMPLE VS. THE COMPLEX IN SCIENTIFIC THEORIES

There seems to be a growing feeling that our present hypotheses concerning the structure of matter, and its relation to electricity, are becoming unsatisfactory. The reason for this is the increasing complexity of the phenomena, as we see them, and of the corresponding explanations which this involves. This feeling does not seem to be well founded. A former cave dweller, who has been for a few thousand years an inhabitant of some of the regions which Dante has described, would find our modern life an array of very complex phenomena.

He would observe that empty apartment houses attract homeless families. He would learn that this could not be accounted for by Newton's law of gravitation, although gravitational attraction between houses and people certainly does exist. He might feel inclined to give up Newton's law, because it does not explain all attractions. He finally learns that ether waves are involved in this phenomenon. The people must see the house before it can have any attraction for them. He would learn that the architecture of the house really appeals to the minds of these people. Being something of a philosopher, he constructs a mental field of force, which lays hold of the building and its surroundings, and which proceeds from the conscious beings. He is greatly interested in seeing that people appear very much alike, while houses differ very greatly in construction, in material and in mass.

As he has not yet learned anything about electrical and kindred phenomena, our visitor may be excused if he refers to the people as negative electrons or ions, and to empty houses as positive ions. When a house contains families enough, so that it ceases to have any attractions for more, he calls the combination an atom. He observes that more people can be forced into a house already normally filled, but the motive forces must come from some external source.

He finally learns that a family which has been more or less forcibly ionized, and is about to enter a new home, must deliver to its former occupant and owner, the value-equivalent of a certain number of foot-pounds of mechanical work previously done. The value-equivalent of this mechanical work may exist in the form of a certain number of grams of some valuable substance which is actually delivered. The value to be transferred may also exist potentially in the form of credit at a bank. The transfer of this value may then be effected by entries in the books of the bank, which transfer credits from one customer to another.

By the time our visitor has learned all these well-known things, it would appear that he

should not be greatly alarmed at present developments concerning electrical phenomena.

We know that molecules on the sun are in constant wireless communication with molecules on the earth. We can partially interrupt this communication by interposing a screen having a diameter of a centimeter or two. The molecules within the shadow now receive impulses transmitted to them by those outside of the shadow.

Here we have an action which is sufficiently amazing. Any explanation which we might make of it could not involve anything more wonderful than the action itself.

After we admit the existence of matter and of electrical phenomena, as we now know them, why may we not assent to the proposition that all atoms of matter are composed of positive and negative electricity or of positive and negative ions? This is essentially Franklin's hypothesis, deprived of its occult features, by reason of what has since been learned. The conductors in a power service are then aggregations of positive ions, or of positive electricity. The negative ions, or, as Franklin would have stated it, the electrical fluid, flows through what we now call the positive ions. Their rhythmical transfer from atom to atom accounts for the Joule effect. In addition we may have conditions which involve an actual and sudden transfer of kinetic energy from the moving negative ions to the positive ions. Such a case we have in the electric arc, which seems to me to be mainly a Thomson effect.

It is now established that the positive and negative discharges, which Wheatstone examined with the revolving mirror, are in the nature of compression and rarefaction waves. They are waves in Franklin's fluid. The negative terminal of any battery or dynamo is the compression terminal. From this terminal Franklin's fluid flows.

The writer has obtained photographs of the Wheatstone sparks and Wheatstone's conclusions concerning direction of propagation of the discharges from the terminals have been fully verified.

FRANCIS E. NIPHER

SCIENTIFIC BOOKS

Research in China. In three Volumes and Atlas. Vol. I., Part I. *Descriptive—Topography and Geology.* By BAILEY WILLIS, ELIOT BLACKWELDER and R. H. SARGENT. 4to, pp. xiv + 353 + index. Pls. LI.; figs. 65. 1907. Vol. II. *Systematic Geology.* By BAILEY WILLIS. 4to, pp. v + 133 + index. Pls. VIII. July, 1907. Published by the Carnegie Institution of Washington.

These admirably written and illustrated volumes should be read by all scientists interested in the geology of Asia and also by those interested in the larger problems of diastrophism and geologic history. The first and larger volume will be used more especially as a work of reference for details of Chinese geology; the second volume treats the same material in a condensed and systematic manner, following the course of geologic history and covering to some extent the whole of eastern Asia. Applying throughout the recently developed principles of diastrophism and physiography, a field of research in which the senior author has previously done distinguished work, these volumes mark a distinct advance over the previous comprehensive treatises dealing with this region, von Richthofen's "China" and Suess's "The Face of the Earth." The atlas, by the incorporation of Chinese characters, has been made readily available to the Chinese, and in the modern educative awakening of China such a publication dealing with that portion of the world may be of material aid in stimulating an interest in the earth sciences. It must not be thought, however, with national self complacency that the general educative effect need be restricted to China. The photographs and descriptions of certain districts bring home the desolation which may result from reckless deforestation, with the consequent sweeping of soils from the hillsides and burial of valley alluvium beneath sand and gravel. This is a lesson the American people still need to learn and the material has already been utilized by the *Outlook* and the *National Geographic Magazine.*

The route of the expedition lay first into the Shantung peninsula, thence from Peking southwestward through north central China

to the Yang-tzi-kiang. In so far as the survey was necessarily rapid it partook of the nature of a reconnaissance and was restricted to type areas and to limited widths of territory, but it was of a character greatly superior to most reconnaissances in that the topography and geology within these limits were accurately mapped and comprehensively studied. Future work, therefore, needs simply to extend what has been already so well begun.

A brief summary is not included in the publication and a review may, in passing, mention the prominent features of the geologic history as set forth in the second volume. The Archean is restricted by the author to the metamorphic schists and gneisses of indeterminate character associated with a large proportion of metamorphosed igneous rocks, which by their intricate structure and inferior position to the oldest pre-Cambrian recognizable sediments are marked as belonging to a distinct and older system. The overlying Proterozoic was chiefly studied in the Wu-Tai-Shan and is divided into two systems, the eo- and neo-Proterozoic, the local Chinese names being omitted in this review. The eo-Proterozoic embraces three series separated by two unconformities.

> Von Richthofen placed this system in the Huronian, using the latter term, as was commonly done thirty years ago, to suggest pre-Paleozoic rocks of green color. He did so with reserve, however, and the stricter usage of the term as it is now adopted does not permit us to maintain an exact correlation.

Willis points out, however, the strong similarities of these three series to the three Huronian series of the Lake Superior region and Van Hise has more recently compared them with still other formations of other regions similar in lithologic character and age relations. As Willis states:

> The general relations to the Archean and neo-Proterozoic are similar in both continents, and the effects may well have been due to a general terrestrial cause which became active at about the same time, in regions remote from one another.

Between the eo- and neo-Proterozoic occurs a stratigraphic break of the first order, indicated both by a great unconformity and by the folding and metamorphism of the lower system which are absent from the upper. The little altered, slightly slaty beds of the neo-Proterozoic resemble the Paleozoic above far more than the eo-Proterozoic below. At least 10,000 feet of slates, limestones and quartzites are embraced in this system. After a period of diastrophism the wide-spread land surface was reduced to a nearly perfect plain over which finally passed in places the Cambro-Ordovician sea. This pre-Paleozoic peneplanation was observed over a stretch of a thousand miles and is a feature of southeastern Asia.

> The fact that Asia at the opening of the Paleozoic era was a featureless continent has important bearings. It limits the antiquity of mountain ranges, some of which have been discussed by eminent writers as of pre-Cambrian date, as elevations which have survived since that remote time; and it affords a basis of inference regarding a cycle of inactivity, which was common to other continents as well.

The marine invasion which initiated the Paleozoic sedimentation began in the late Lower Cambrian and gave rise to the Sinian group, extending to the Middle Ordovician. In central China the Sinian is composed of limestone, apparently to its very base, but in north China the characteristic strata of the Lower Sinian are red deposits. In south China, latitude 31° north, near the base of the Sinian and conformably interbedded between a quartzite below and marine limestone above occurs the bed of tillite which has attracted so much attention on account of the profound significance of this early glaciation near the level of the sea.

The Lower Ordovician strata are overlain by Upper Carboniferous, but without discordance of dip, implying prolonged quiet with most of the continental surface lying near sea level. The Carboniferous is characterized by marine deposits in the south, by continental deposits in the north. The transition to the Mesozoic is not marked by a sharp division plane, but by shrinkage of the seas and an increase in the proportion of continental deposits. At the same time Permo-Mesozoic diastrophism was pronounced and the present

structure lines of Asia were largely established. By the Cretaceous, however, Asia was again a low and featureless continent.

The Cenozoic history is one of erosion and land deposit. The Cretaceous peneplain conditions were continued at least in southern Asia through the Eocene and Oligocene and well into the Miocene, when occurred the epoch of mid-Tertiary compression resulting in folding. Since then there have been extreme effects of vertical warping unaccompanied by folding and chiefly of Pleistocene age. The evidence of the latter is largely physiographic and indicates "one of the most remarkable diastrophic movements of which we have knowledge." The Neocene and Pleistocene warping and faulting are believed to have produced differences of elevation exceeding 20,000 feet. Davis and Willis are thus in accord and stand in opposition to the earlier views of European geologists, in that these American investigators hold that the elevations due to Permo-Mesozoic folding or older epochs of diastrophism were long since planed away by erosion and are not the causes of the present relief. These views, developed first in America, are thus made of circumterrestrial application and may be regarded as the great contribution of physiography to geologic theory.

The paleogeographic maps are a feature of this report, as is also the map showing the results of the recent diastrophism.

In the final chapter Willis considers the bearing of the previous facts and conclusions upon the problem of the continental structure of Asia. No adequate outline of this chapter can here be presented. In brief, however, he finds that the continent may be resolved into positive and negative elements, the former areas tending to stand high, the latter tending to stand low. These tendencies are latent during comparatively long periods of quiet and resultant peneplanation, but become operative during epochs of diastrophism. The compressive movements, on the other hand, have pressed and welded the positive elements together, the axial directions of folding representing the compression of the negative zones lying between.

The cause of the diastrophism Willis ascribes to differences in specific gravity, restricted according to Hayford's determination to the outer hundred miles of the earth's body; the vertical movements being chiefly due to isostatic readjustment between the several continental elements, the compressive movements being due to the tendency of the heavier oceanic segments of the earth to spread and underthrust the outer portions of the whole continental mass.

For more than a third of a century the incompetency of secular cooling of the outer crust to account for diastrophism has been pointed out,[1] though it still finds credit in many text-books. Chamberlin, recognizing this, has constructed a hypothesis by which periodic compressive movements are ascribed to a shrinkage of the centrosphere and not the lithosphere. Willis goes still farther and obviates the necessity of postulating shrinkage of either the inner or outer earth. His hypothesis thus belongs to that group to which O. Fisher and Dutton have previously contributed.

This must be regarded as a most suggestive working hypothesis, opening the field still wider to investigation, and may serve to destroy still more the false confidence regarding the cause of crustal movements which was felt by geologists of a previous generation, owing to the narrowly limited hypotheses then in vogue.

The hypothesis advanced by Willis is an extension of that proposed by Dutton, who ascribed folding to that subcrustal horizontal creep from the low toward the high elements which is necessary to isostatically restore the initial elevation of the high and the initial depression of the low.[2]

In the form in which Dutton stated the hypothesis it appears insufficient, since the

[1] C. E. Dutton, "A Criticism upon the Contractional Hypothesis," *Amer. Jour. Sci.*, Third Series, Vol. VIII., pp. 113–123, 1874.

[2] C. E. Dutton, "On Some of the Greater Problems of Physical Geology," *Bulletin of the Philosophical Society of Washington*, Vol. XI., pp. 51–64, 1889.

horizontal movement shown by folding seems far in excess of the subcrustal creep in the outer fifty or hundred miles of the earth's crust needed to restore the isostatic adjustment between the regions on the two sides of the zone of folding. Furthermore, the vertical readjustments which take place in epeirogenic movements are not simultaneous in origin with the horizontal movements.

Somewhat similar difficulties seem to face the larger hypothesis of Willis in which continental and oceanic segments are concerned rather than adjacent geanticlines and geosynclines. The average continental surface stands about three miles above the average ocean bottom, owing to the lighter subcontinental matter. The isostatic compensation, as Hayford has shown, is complete at a distance of about seventy to a hundred miles from the surfaces. A column of matter on the edge of an oceanic segment and extending to this depth will consequently have its top pressed seaward by a pressure due to the greater height of the continental mass, a pressure resisted by the rigidity of the surface of the oceanic segment. The foot of the column, however, will not be strained in either direction, since the weights of the continental and oceanic segments at this depth are equal. Any intermediate point in the column will be pressed seaward with an intermediate pressure.

The initial cause of that horizontal movement which is due to isostatic adjustment on the continental margins would, therefore, be an outward spreading of the continental margin by flowage and normal faulting. The surface being lowered by this means, the subcontinental pressures would be lessened and a landward movement of the lower zone of the oceanic segment would in turn tend to take place, restoring in this manner a part of the initial height. It is difficult to see, however, how compression of the continental surface could ever occur as a result from this spreading except for local and minor adjustments, since the flowing outward of the surface is the operating cause. In so far as sediment from the continents is deposited on the bottom of the oceanic segments, however, and the surfaces of the two are brought toward a common level, the tendency of the top of the continental segments to spread outward will be checked and a tendency for the lower part of the oceanic segment to underthrust the land will arise. But the greater part of terrigenous sediments have been deposited within continental geosynclines, or upon the lower continental elements, or as submarine deltas building slightly outward the continental shelves. The isostatic readjustment should, therefore, be largely between the high and low continental elements and it is not clear that sedimentation could account in any large measure for such a crowding together of the continental elements by pressure from the oceanic segments as the structure of Asia seems to suggest. Furthermore, Willis has shown that the present great relief of Asia is the result of a very recent movement unconnected with the Permo-Mesozoic folding and but partly originating in the mid-Tertiary period of orogenic activity. It seems best, therefore, to consider that vertical movements, bringing about isostatic adjustment, are but indirectly connected with the great compressive movements, following after them to a greater extent than accompanying them; due to a seeking for an equilibrium destroyed on the one hand by erosion and sedimentation, on the other by changes of specific gravity from within, induced partly by the previous horizontal compression. Horizontal compressive movements, on the other hand, characterized by their large amount and brief duration and separated by relatively long periods of quiet, seem to have found as yet no better explanation than that advanced by Chamberlin, as due to a progressive shrinkage of the entire central portion of the earth, resisted by the rigidity of an outer unshrinking zone many hundred miles in thickness. This gives the necessary mechanism for the gradual storage of compressive stress and its periodic discharge by yielding of the outer zone, a yielding characterized by the mashing of geosynclines and other lines of weakness in the outer shell, and the underthrusting of the continental surfaces by the lower and structurally stronger oceanic segments.

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Principles of Breeding. A treatise on thremmatology, or the principles and practises involved in the economic improvement of domesticated animals and plants. By E. DAVENPORT, M.Agr., LL.D., with appendix by H. L. RIETZ, Ph.D. Boston, Ginn & Co. 1907. Pp. xiii + 727.

It is likely that most writers will follow Bateson in using the broader term "genetics" for the subjects covered in this volume, rather than the older and more restricted term "thremmatology," proposed by Lankester, even if for no other reason than ease of pronunciation. However this may be, contemporary investigators seeking the facts of development, variation and heredity are fast accumulating vast quantities of data, past investigations are receiving renewed attention in the light of recent discoveries, and the author who undertakes the often thankless task of compiling a text-book from the varied lines upon which these subjects border, deserves the gratitude of all who are interested in the field. Dr. Davenport brings to his aid fifteen years' experience in presenting these matters in the class-room, and the result is a well-planned and logically developed treatise, written in such clear English that a college student should have little difficulty in seeing the matter with the author's eyes. It may be that all students of genetics will not accept his views upon disputed subjects, for they are the views of an ardent biometrician; it is positive that there will be a difference of opinion as to the relative importance of certain phases of the subject; yet this is the fate of all text-books, particularly those in a new field. There is hardly a doubt but that the statistical method of dealing with problems of heredity is unduly favored; and when the author asserts that "it is the only reliable method of attacking problems in transmission," cytologists and investigators using pedigree culture methods will lend their approbation only so far as to admit that a knowledge of the theory of statistics is a valuable *adjunct* to any line of work. On the other hand, the method of handling the older debated questions of general biology—acquired characters, etc.,—is eminently fair and equitable.

The book is divided into four parts: in the first three, of increasing length, are discussed the kinds of variation, the causes of variation, and the transmission of characters, while the much shorter fourth part is devoted to practical problems. In a short appendix Dr. Rietz gives an excellent introduction to the theory of probabilities. Additional literature is cited at the end of each chapter, which, in the hands of a teacher familiar with all branches of the subject, would be a valuable basis from which to make selected lists for collateral reading. Unfortunately the classics cited are not distinguished from absolutely valueless articles, and such extended lists might thereby become rather more of a hindrance than a help. The originals are cited only when in English; the foreign work, which forms a large portion of the literature in genetics, is therefore noticed only in the form of English abstracts.

After an introductory chapter on the general nature of variability, variation is treated under the heads morphological, substantive, meristic, functional and mutational. The discussion under the first two heads, variations in size and quality, are quite short. We miss any consideration of the facts relating to the difference between mere bigness due to nutrition and inherited size due to gametic structure, which from its importance to the breeder we might reasonably expect. More extended treatment is given to the third type, the examples and text figures being drawn almost wholly from Bateson. Under functional or physiological variation, however, we are indebted to the author for a wealth of new illustrations, many of which are from experiments with beef and dairy cattle and with maize, that have never before been published. Under mutations the author gives to the reader the same impression (and the reviewer believes this time unintentionally) that has caused, and is still causing, false impressions among out and out Darwinians as to the true con-

ception of a mutation. All opponents and many adherents of de Vries seem to be able to conceive a mutation only as the addition or loss of a complete character and therefore a wide jump. That such a change sometimes takes place, the mutationist believes, and so also does the Darwinian (or at least so also did Darwin), but by far the larger number of mutations are quantitative changes in characters already possessed, *i. e.*, simply the production of new modes as centers for linear fluctuation. The difference between fluctuations and mutations is merely in their transmission.

Part II.—Causes of Variations—begins with an admirable non-technical description of cell division, followed by a development of the actual theme, in which are taken up first, internal causes which affect the individual, and second, those which affect the race. One can not help but be struck with the logical manner in which the author disposes of old, popular myths, such as telegony and intrauterine influences, by appealing to the law of error. It is also gratifying to know that he has found by correspondence that practical breeders, for example dog fanciers, seem to be outgrowing their past childlike faith in these things. It is likely that this book will do much toward changing such superstitions as belief in maternal impressions in the next generation of animal breeders. Modern biometry as based on the theory of probability seems to the reviewer to have its greatest value to practical breeders in showing how illogical it is to consider isolated cases as proofs of a biological principle, and considerable emphasis is given by the author to this point. It is hardly likely that many present-day farmers will study thoroughly so bulky and technical a volume, although the author hopes to reach them, but their sons who have had some training in genetics in our agricultural colleges will be given a broader and more scientific point of view.

A large portion of the remainder of Part II. is devoted to external causes of variation. This portion is almost wholly an abstract of C. B. Davenport's "Experimental Morphology." Then, as a transitory introduction to Part III. on "Transmission," follows a very judicial treatment of the inheritance of acquired characters. Here, again, the theory of probability is utilized to show that instances of apparent transmission of somatic modifications are, at least, doubtful—a judgment which the most ardent Lamarckian could hardly question.

A considerable percentage of the remainder of the part is devoted to pure biometry which the author believes to be the coming method for attacking genetic problems. The elements of biometry are explained with greater clearness than in any other English publication, and as such are to be highly recommended. The elaboration of the results of Karl Pearson and his school, however, shows too great a trust in Pearson's lame biology.

It will be exceedingly unfortunate if there is a promulgation of this idea of certain biometricians, namely, that valuable biological conclusions can be drawn where there have been no biological premises, by the mere fact of complex, mathematical treatment. As an example of a biometrical explanation which explains nothing the following may be cited (p. 537):

> The principal function of selection, therefore, is to *alter the type, not to reduce variability*, and the facts here cited show the *inherent impossibility* of "fixing" the type in the sense that individuals will not depart from it. But, on the other hand, the same principle assures us that, however much we improve by shifting the type, there always remains sufficient variability for further selection, *and so long as variability remains there is hope and possibility for still further improvement.*[1]

Compare this view with that of Johannsen. (By the way, the epoch-making work of Johannsen on "pure lines" is not mentioned.) The latter considers the variation's curve of a quantitative character of any general population to be made up of numerous family lines. Members of these family lines are true to their own type, their fluctuations being due to nutrition, etc., and not inherited. The rôle of selection, therefore, is to isolate a family

[1] Last clause italicized by E. M. E.

line from a heterogeneous mixture of small types differing gametically among themselves. Here we have a real explanation compatible with the belief that to be inherited variations must have affected the germ cell structurally—a view to which the author apparently adheres.

Mendel's original investigations are briefly discussed by the author, but all of the numerous, recent contributions along this line are left untouched. Of course the immense amount of labor necessary to compile a book of seven hundred pages in a new subject would necessitate the work being actually behind the date of the preface, but one would like to see more notice taken of the many valuable investigations of contemporary biologists. A more extended consideration of late cytological and Mendelian research would have changed materially the author's treatment of atavism, prepotency and the determination of sex.

The work as a whole, however, brings together an enormous number of facts along diverse lines, and, though largely zoological, will undoubtedly prove of great value as a reference basis for a course of lectures on the subject, even if the new facts, which are continually being contributed in such profusion, make it of less value as an ironclad text-book.

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Mushrooms, Edible and Otherwise. By M. E. HARD, M.A. Large octavo. Pp. xii + 609, with 504 half-tone figures from photographs, many of them full-page plates. Distributed by The Ohio Library Co., Columbus, Ohio.

Under the above title Mr. Hard has given us an exceedingly interesting and valuable book upon a subject in which every one is interested, whether he is a botanist or not. The book is intended primarily for the beginner and a chapter including such subjects as, Why Study Mushrooms? Mushrooms and Toadstools, How to Preserve Mushrooms, etc., and An Analytical Key, is written in words so simple and yet so accurate that even the beginning student will gain a ready hold upon the group and will not be encumbered with a load of useless and unscientific data. As the late Dr. Kellerman states in the introduction, "The author does not write for the specially educated few, but for the mass of intelligent people—those who read and study, but who observe more." Thus the work is intended to appeal more especially to the people at large, but there is also much good in it for the college student of mycology. The generic and specific descriptions, and the great range of forms depicted in word and picture, are so nicely worked out that the book is one of the very best of the American publications of its kind. Without doubt this is the finest and most carefully arranged set of half-tone figures of American Agarics to be found in a single book.

A little more than one half (349 pages) of the book is devoted to the Agarics, the remainder being divided between the Polyporaceæ, Hydnaceæ, Phelephoraceæ, Clavariaceæ, Tremellini, Gasteromycetes, Ascomycetes, and a chapter each on the Myxomycetes, Recipes for Cooking Mushrooms, and How to Grow Mushrooms. These chapters are characterized by the same interesting style and excellent illustrations.

The author is determined that every one shall come to know mushrooms, first from the practical side to be able to identify the edible ones, and finally to know them from a more scientific standpoint, and then to be led to the broader study of mycology as a whole. The student of this book will unconsciously be led along this very path. As one turns the pages of the book he is delighted almost beyond expression, and he feels that Mr. Hard has rendered a great service to science in general and to mycology in particular in giving us this excellent work.

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SPECIAL ARTICLES

NOTES ON THE FIRST GENERATION HYBRID OF ŒNOTHERA LATA ♀ × O. GIGAS ♂

DURING the summer of 1907 three offspring of *Oenothera lata* ♀ × *O. gigas* ♂ were reared to maturity in the garden at the Station for

Experimental Evolution and observations upon the somatic chromosomes of these plants were embodied in a report read at the Seventh International Zoological Congress.

The peculiar combination of parental vegetative characters in each of these hybrids, associated with a certain fixed number of somatic chromosomes, suggested the desirability of repeating the cross upon a much larger scale in hopes of throwing some light upon the behavior of chromosomes in inheritance and of determining, if possible, whether number, size and shape of chromosomes are regularly associated with the inheritance of certain definite external characters.

In a previous note *O. gigas* was reported to have double the number of chromosomes found in *O. lamarckiana*, with evidence to suggest that the number may vary within a limited range among individuals of the species.[1] Gates[2] later sustained the count of 28 for *gigas* from observations of the germ-cells. In an earlier paper he reported 14 chromosomes for *lata*.[3] The few individuals of this species which I have examined have given 14 and 15 chromosomes with considerable, though not conclusive, evidence that a single plant had 16.[4] The number for each individual however remained constant.

The striking differences in the number of chromosomes of *lata* and *gigas*, associated with marked differences in external characters, caused the progeny of a cross between individuals of these two species to become a subject of particular interest. Seeds for the first generation offspring of *O. lata* ♀ × *O. gigas* ♂ were secured from guarded pollinations through the kindness of Dr. G. H. Shull. The hybrids arising therefrom were the progeny of a single pair of parents; the pistil parent in this case being a mutant which arose from a culture of pure-bred *lamarckiana* and the pollen parent a pure-bred *gigas*. Seventy-seven young rosettes were transferred to the experimental garden early in May, fixations having previously been made of the root tips of 50 of this number for the study of somatic chromosomes.

By sowing seeds in the greenhouse early in February and transplanting rosettes to the garden as soon as danger of frost is past, *lata*, like *lamarckiana* and others, may readily be brought to flower the first season. *Gigas*, on the contrary, is strongly biennial and even when subjected to the same conditions as *lata* from seed-sowing to maturity only a small percentage can be expected to flower and ripen seeds the first season. Consequently, the fact that 44 of these hybrids were annuals is of considerable apparent significance. It is, however, unsafe to conclude that this is a manifestation of an hereditary character, inasmuch as the majority of those remaining in the rosette stage were subjected to slightly different environmental conditions, having been transplanted to the garden 9 days later than the majority of those which proved to be annuals, and transferred to somewhat richer soil. Designating the two plots as east and west gardens, 47 young rosettes were transplanted to the former May 1 and 3 on May 10. Of the first lot, 37 came to flower during the season, 3 died and 7 have gone into the winter as rosettes.

Twenty-seven rosettes were transferred to the west garden May 10, of which 5 came to flower during the season, though very much later than the majority of those of the same class in the east garden.

The somatic chromosomes of 40 of these hybrids (25 of which were annuals) have been carefully studied and the remaining 10 will be included in the final publication to appear shortly. To insure accuracy of chromosome counts, none was considered conclusive unless sustained by 10 or more perfectly clear figures distributed through 2 or

[1] "A Preliminary Note on the Chromosomes of *Œnothera lamarckiana* and One of its Mutants, *O. gigas*," SCIENCE, N. S., 26: 151–2, August 2, 1907.

[2] "The Chromosomes of *Œnothera*," SCIENCE, N. S., 27: 193–5, January 31, 1908.

[3] "Pollen Development in Hybrids of *Œnothera lata* × *O. lamarckiana* and its Relation to Mutation," *Bot. Gazette*, 43: 81–115, 1907.

[4] "Chromosomes of the Somatic Cells of the *Œnothera*," SCIENCE, N. S., 27: 335, February 28, 1908.

more (usually 3 to 6) separate fixations from each plant. In every case but one, referred to later, the number remained constant for each individual throughout the several fixations. Corroborative evidence was also secured in a number of the exceptional forms by a study of tapetal cells. Hundreds of figures were carefully examined to determine whether individuality in size and shape of chromosomes could be recognized, but no evidence whatever was secured to demonstrate that any such differences exist.

In the majority of these hybrids the exact number of somatic chromosomes has been determined with certainty; but owing to the fact that a few of the intermediates and several of the *gigas*-like hybrids yet require the study of more sections to settle the question of one or two chromosomes more or less, it will be necessary for the present to group them merely under the heads of *lata*, *gigas* and intermediate. The identifications are based both on chromosomal and vegetative characters. While these groupings are sufficient in the main for all classes, II. and III. can well be further subdivided with respect to external characters.

CLASS I., *lata*, is represented by 2 individuals appearing as true *lata* in every point, indistinguishable from *lata* mutant from earliest seedling stage, and having *lata* number of chromosomes—15. Both annuals.

CLASS II., *gigas*, consists of 6 plants having *gigas* number of chromosomes (30 in each case so far definitely counted). Two of the 6 plants were annuals; one resembled *gigas* far more strongly than any other hybrid coming to flower in the garden, yet hardly to be classed as a good typical *gigas*. The second annual resembled the individuals of Class III. in a few, and pure *gigas* in the majority, of its vegetative characters. A peculiar exceptional circumstance is connected with the microscopic study of this plant. Fixations of root-tips, prepared April 3, gave an intermediate number of chromosomes. Another dated April 11 showed the *gigas* number with equal clearness, while a third was poorly fixed and gave no hint to settle the question. A fourth fixation of tapetal cells was made in August and clearly demonstrated the higher number. It therefore seems probable that the first fixation was taken from a member of Class III., and the confusion arose from an error in labeling. It is upon the basis of this conclusion that I have included this plant within Class II. rather than III.

The third plant under this head (biennial) was characterized in early seedling and rosette stages by whitish markings, so conspicuous in *albida* at corresponding stages of development. It differed markedly from the latter, however, in shape of leaf. The three remaining biennials differ considerably from one another, but equally pronounced differences have been noted among individuals of pure *gigas*. The members of this class, however, form the least homogeneous group of the three with respect to external characters.

CLASS III. is represented by 32 individuals, 21 of which were annuals. A portion of these had 22, others 23 and some possibly 21 chromosomes, although evidence is not yet complete in regard to the last. With respect to vegetative characters, the plants of this group fall readily into 3 subdivisions:

1. Consists of a single individual, remarkable for its narrow leaved, *gigas* type of foliage, utterly unlike that of *lata*. A single lateral flowering branch produced a few buds and flowers which were noted as "intermediate."

2. Is composed of those individuals which may be classed as true intermediates and includes 12 of the 21 annuals of Class III. The main features characteristic of this group are as follows: resembled *lata* in imperfect unfolding of petals, scarcity of pollen produced, sterility of pollen and shape of first buds; resembled *gigas* in size of corolla (with several exceptions), and various parts of flower, in red tinting of sepals (particularly in latter part of the season), and in general vigor of the plant.

3. Is in many respects the most interesting of all. It is composed of those individuals of class III. that have long slender buds, flowers with smooth petals and yield a moderate abundance of pollen. It may again be properly subdivided into *a* and *b*; the former consisting of three plants attaining the height of

lamarckiana and being indistinguishable from it in manner of branching and large number of flowers produced. A fourth member of this group bloomed late in the season and did not attain its full stature. The buds of these peculiar hybrids might have been classed as stout *lamarckiana* or slender *gigas*. The sepals remained conspicuously yellow, attaining near the end of the season a faint tint of red, like extracted *latas* of this cross. The foliage resembled *gigas*.

The second half of this group consisted of four plants somewhat resembling the first in size and branching habits but, in three of the four individuals, distinguished from it by the deep red color of the sepals—strikingly resembling *rubrinervis* in this regard. The fourth plant had less deeply colored sepals and possibly should be placed in a subdivision of its own.

The appearance among the offspring of *O. lata* × *O. gigas* of plants with pronounced *lamarckiana* characters is puzzling. The combination of these with equally pronounced *gigas* characters, further associated with the intermediate number of chromosomes, precludes the possibility of the pistil parent having been accidentally fertilized by *lamarckiana* pollen. MacDougal[5] succeeded in fertilizing *lata* with its own pollen for the first time on record, and obtained seed which "gave rise to a progeny which showed only the constitutents usually found in a progeny of this plant when fertilized by *lamarckiana*."

Study of the pollen of these hybrids is as yet in the initial stages, but some interesting observations have already been made.

Pollen grains of *O. lamarckiana, O. lata, O. nanella, O. rubrinervis* and *O. cruciata* are, so far as I have observed from the cultures growing at the station this summer, characteristically 3-lobed as figured by Gray[6] for *Œnothera*. Limiting observations to the first two forms mentioned, ordinarily about 1 in 1,000 grains has been found to have 4 or more lobes, although as high as 15 per cent. has been observed in normal, typical individuals. Seven representatives of pure *gigas* were examined and the 3-lobed grain was found to occur as rarely in this species as the 4 and 4 + grains in *lamarckiana*. Four-lobed grains prevailed for most individuals of *gigas*, although these were commonly found mixed with 5-, 6-, 7- and even 8-lobed grains, usually decreasing in frequency with the increase in the number of lobes. A further interesting point brought out was the fact that certain individuals showed these extra lobes in all stages.

The study of the pollen of the hybrid progeny of *O. lata* × *O. gigas* was therefore of absorbing interest.

CLASS I. (two extracted *latas*) showed 3-lobed pollen with an exceptional extra-lobed grain, as is characteristic for a *lata* mutant.

CLASS II., composed of two adults with *gigas* number of chromosomes gave each 4 and 4 + grains with an exceptional 3-lobed individual as is characteristic for pure *gigas*.

CLASS III. (hybrid number of chromosomes), pollen of seven individuals studied each gave a mixture of 3- and extra-lobed grains. The proportions have not yet been ascertained, but it is clear that the former are usually considerably in excess of the latter.

The sterility of *lata* is due not only to the scarcity of pollen produced, but to the large percentage of bad grains. The amount yielded by any form was found to vary with the individual, with the flower of the individual, and with the anther of the flower. Even the most fertile forms produce a surprisingly large percentage of bad pollen, and some of the above hybrids, notably certain members of Class III., subdivision 3, have been found to have as high as 90 per cent., although pollen was produced in moderate abundance. Inasmuch as *lata* yields but very little pollen, mostly bad, and *gigas*, while producing a considerably larger quantity, has in most instances a low percentage of good grains, it is not at all surprising that it was utterly impossible to artificially self-pollinate the majority of these

[5] "Mutations, Variations and Relationship of the *Œnothera*," by D. T. MacDougal, A. M. Vail and G. H. Shull. The Carnegie Institution of Washington, Papers of Station for Experimental Evolution No. 9.

[6] Gray's "Lessons and Manual of Botany," revised edition, 103, fig. 316.

hybrids, although attempts were persistently repeated throughout the summer. However, a few seeds were obtained from individuals having respectively *lata*, *gigas*, and intermediate number of chromosomes and the plants derived from these will form the chief subject of study for the coming year.

To summarize briefly:

The first generation offspring of *O. lata* ♀ × *O. gigas* ♂ fall into three main groups with respect to external characters and number of chromosomes; namely, *lata*, *gigas*-like and intermediate. Considering external characters only, the latter two should be further divided and subdivided.

Numbers of chromosomes are closely associated with external characters in the first and last, and probably also in the second group.

Pollen grains of two parental forms differ in number of lobes and these are inherited.

ANNE M. LUTZ
STATION FOR EXPERIMENTAL EVOLUTION,
COLD SPRING HARBOR, L. I.,
December 7, 1908

MUCOR CULTURES

IN the study of the Mucoraceae for several years, some interesting facts concerning the development or rather the non-development of zygospores were observed. The experiments were made with the common *Mucor stolonifer* Ehrenberg. The media used were bread, pumpkin, orange, cornmeal, decoction of horse manure with gelatine, Pasteur's solution with gelatine, Hamaker culture medium.[1] The cultures were made with sterilized and unsterilized media. The spores for inoculation were taken from plants grown in the laboratory, from specimens collected for the herbarium, and from specimens sent to us by friends. In one thousand cultures not one zygospore was discovered.

In addition to the cultures, five hundred specimens of this species found growing spontaneously in different places were also examined but not one zygospore was observed.

Besides these experiments, many cultures were made and many specimens examined, a record of the exact number of which, however, was not kept. It is a conservative estimate to say that five hundred observations of this kind were made. This makes a grand total of two thousand observations without a single zygospore.

[1] Hamaker, SCIENCE, XXIII., 710, 1906.

Experiments were also made to determine the development of this Mucor under anaerobic conditions. The media used for these experiments were orange, bread and Hamaker culture medium. All were sterilized. In giving the results of these experiments below, the word cornmeal will be used for the Hamaker medium. Cornmeal is the principal constituent of the medium. The material for inoculation was kindly furnished by Dr. Niewland, of Notre Dame University.

Small wide-mouthed bottles were used for the cultures. The medium was placed in the bottles and the bottles then closed with cotton and all sterilized. After inoculation, the bottles were placed into Novi jars and the jars filled with gas. The jars with the bottles were then set aside for observation. The following results were obtained.

In Hydrogen.—On orange, mycelium developed but few sporangiophores, no zygospores; on bread, no development; on cornmeal, no development.

In Nitrogen.—On orange, mycelium and few sporangiophores, no zygospores; on bread, about the same result; on cornmeal, about the same result.

In Carbon Dioxide.—On orange, mycelium well developed but few sporangiophores; on bread, mycelium profusely developed, many sporangiophores, no sporangia, no zygospores; on cornmeal, no development.

It seems that the absence of oxygen is not a necessary condition for the growth of zygospores.

DAVID R. SUMSTINE
UNIVERSITY OF PITTSBURG

THE BOTANICAL SOCIETY OF AMERICA

A UNION OF THE BOTANICAL SOCIETY OF AMERICA, THE SOCIETY FOR PLANT MORPHOLOGY AND PHYSIOLOGY AND THE AMERICAN MYCOLOGICAL SOCIETY

THE third annual meeting of the federated societies (the fifteenth of the Botanical Society

of America) was held in the Eastern High School, Baltimore, Maryland, December 28, 1908, to January 1, 1909, under the presidency of Professor W. F. Ganong. Over sixty members were in attendance at the meeting, which seemed generally regarded as unusually successful. The arrangements made by the local committee for the American Association concerning rooms, stereopticons, etc., proved entirely adequate and satisfactory.

The officers of the society for 1909 are:

President—Professor Roland Thaxter, Harvard University.

Vice-president—Mr. A. F. Woods, Bureau of Plant Industry.

Treasurer—Dr. Arthur Hollick, New York Botanical Garden.

Secretary—Professor D. S. Johnson, Johns Hopkins University.

Councilors—Professor J. M. Coulter, University of Chicago; Professor Wm. Trelease, Missouri Botanical Garden; Professor F. E. Clements, University of Minnesota.

Five associate members were elected to full membership, and eight botanists were elected to associate membership.

The next annual meeting of the society will be held in conjunction with the American Association for the Advancement of Science.

Important features of the program were the special addresses given on invitation of the council by Professor Roland Baxter, of Harvard University, and Professor J. C. Bose, of Presidency College, Calcutta; the addresses on "Vascular Anatomy," by J. M. Coulter and E. C. Jeffrey; the symposium on "Present Problems in Ecology," with papers by H. C. Cowles, B. E. Livingston, C. H. Shaw, V. M. Spalding and E. N. Transeau; and, finally, the estimates of Darwin's work in botany, given at the Darwin Memorial Session of the society by Wm. Trelease, H. M. Richards and F. E. Clements.

It is planned to publish in full in *The American Naturalist* the addresses on "Vascular Anatomy," on "Plant Ecology," and those given at the Darwin Memorial Session. Reprints of these papers will then be distributed to members of the society.

The scientific session of the society on Thursday morning, December 31, was devoted to the reading of papers which were organized into two programs given simultaneously. Abstracts of these papers follow:

The Structure and Organization of Pediastrum: Professor R. A. Harper, University of Wisconsin. By title.

Illustrations of Some of the Types of Coralline Algæ: Dr. M. A. Howe, New York Botanical Garden.

The speaker exhibited a series of lantern-photographs, illustrating the form, structure and habits of growth of the dominant types among the Corallinaceæ. The specimens selected for photographing were collected chiefly on the shores of Newfoundland, Maine, Florida, Bermuda, the Bahamas, Jamaica and Porto Rico. Certain calcareous Chlorophyceæ, often confused with the Corallinaceæ by the earlier naturalists, were also illustrated. The structure of several genera of unsegmented corallines was exhibited by means of photomicrographs. Of special biological interest were photographs showing corallines growing attached to living corals and indicating competitive struggles for existence between calcareous plants and calcareous animals. The speaker alluded to the wide geographic range of the corallines and to the discovery by the late Professor Kjellman of extensive beds of *Lithothamnion glaciale* off the coasts of Spitzbergen and Nova Zembla, more than twelve degrees north of the Arctic circle. Mention was made, also, of recent investigations tending to show that reef-building and land-formation in certain regions have been due to the growth of calcareous plants fully as much as to the corals.

The Male Gametophyte of Dioon edule: Professor C. J. Chamberlain, University of Chicago.

The staminate cones of *Dioon edule* shed their pollen in September, the male gametophyte at this time consisting of a prothallial cell, a generative cell and a tube cell. The generative cell divides in October, forming a stalk cell and a body cell, and the latter divides in the following spring, giving rise to two sperms. The sperms are formed within two sperm mother cells and swim freely within the mother cells before they escape into the tube cell.

The blepharoplasts are first distinguishable in the body cell and are very probably of nuclear origin. The radiations about the blepharoplasts arise by a transformation of the cytoplasm, but owe much of their subsequent growth to granules of nuclear origin. During the transformation of the blepharoplast into the spiral band, the band is closely connected with the nucleus, both morphologically and physiologically.

The mature sperms not only swim actively by means of cilia, but have an amœboid movement. In escaping from the pollen tube, they may be constricted to less than one fourth their normal

diameter, but readily regain their form. The cilia continue to move even after the sperm has penetrated the egg, but the nucleus soon slips out from the cytoplasmic sheath and moves toward the egg nucleus.

Some details in the transformation of the blepharoplast into the spiral band, as well as details in the origin and development of cilia, are better shown in *Ceratozamia* and will be treated in greater detail in the forthcoming paper on that genus.

Further Studies of Œnotheran Cytology: Dr. R. R. GATES, University of Chicago.

In a recent paper[1] I described the method of chromosome reduction in *Œnothera*, using *O. rubrinervis* and several of the other mutants as types. I have since examined the various stages of reduction in the wild *O. biennis* and in *O. lævifolia*, and the observations confirm in practically every detail the results recorded in that paper. In both of these forms the chromosome number is fourteen, the reduced number being seven.

The essential points in the method of reduction may be briefly stated as follows:

After synapsis a single thick spirem is finally formed, which breaks into a chain of fourteen chromosomes lying mostly attached end to end. These do not always pair with each other, but frequently lie unpaired on the spindle. In the heterotypic mitosis half of them pass to each pole. Each divides during the later stages of this mitosis, and the halves are separated by the homotypic mitosis. The first mitosis thus separates whole chromosomes and the second mitosis the (probably) longitudinal halves of these. The chromosomes become so nearly globular that the direction of this split is not easily determined.

On account of the weakness of the attraction between homologous chromosomes at the time of pairing, many of them lie unpaired on the heterotypic spindle; and this allows of occasional irregularities in their distribution. Such irregularities provide a possible basis for the origin of mutants having the same number of chromosomes but lacking certain groups of characters, provided, of course, that the chromosomes are qualitatively different.

The Type of the Genus Cactus: Dr. J. N. ROSE, U. S. National Museum.

Edaphic Conditions in Local Peat Bogs: Dr. G. P. BURNS, University of Michigan.

[1] "A Study of Reduction in *Œnothera rubrinervis*," *Bot. Gaz.*, 46, 1–34, 1908.

Beginning with the open water, the plant societies usually found in the peat bogs near Ann Arbor are the aquatic, bog-sedge, bog-shrub, tamarack, maple-poplar and willow or marginal societies. A study was made of the distribution of these societies at different lakes and records were made of the variations in the edaphic factors influencing the different societies.

The data obtained indicate quite clearly that the position of the peat deposit is dependent upon the depth of the water and shape of the shore of the original lake and not upon the direction of the prevailing winds, as has been supposed.

Of the edaphic factors, the position of the water-table in the various areas is the most important. This is subject to wide variations. In the summer of 1905, April 24 to August 5, the variation under the different societies was as follows: bog-sedge, 0 cm.; bog-shrub, 17 cm.; tamarack, 31 cm.; willow or marginal society, 95 cm. In these outer areas fungi and bacteria can work to greater depths, changing the nature of the soil and rendering it capable of holding more and more available water, or in other words less xerophytic.

Continuous temperature records also show that the marginal areas are less xerophytic than those nearer the open water.

Stomata and Transpiration in Tradescantia zebrina: Dr. B. E. LIVINGSTON, Desert Botanical Laboratory.

The purpose of this study is to determine as well as possible to what extent the stomata are influential in causing the transpiration rate to be relatively greater by day than by night. By measuring the stomatal pores and calculating the relative diffusion capacities for night and day, it is found that this capacity in the daytime is about 2.6 times as great as in the night. The influence of the evaporating power of the air in this connection varies, of course, with weather conditions. The greatest difference observed shows an evaporating power for the day of 6 times that of the night. The smallest difference shows a ratio of 1.92. An attempt is made to calculate the transpiration ratio (day to night) by multiplying the evaporation ratio by the ratio of diffusion capacity. The result of this apparently shows that with direct sunlight the calculated transpiration rate for the day is too low, while with diffuse light it is too high. An average of nine tests with diffuse light shows the actual transpiration ratio to be 0.76 of the calculated, but individual tests showed a close approximation.

The conclusion is that, with diffuse light, the

variation in the size of the stomatal pores in *Tradescantia zebrina* (with the resulting variation in diffusion capacity) is amply great enough to explain that portion of the daily rise in transpiration rate which is not dependent upon the variation in the evaporating power of the air. With direct sunlight it appears that the stomatal variation is not large enough to explain this.

The Vegetation of Northern Zacatecas, Mexico: Professor F. E. LLOYD, Alabama Polytechnic Institute.

A general comparison between the vegetation of the region indicated in the caption with that of other desert regions, more especially with that of the vicinity of Tucson, Ariz., in which the greater general density of the vegetation of the Zacatecas desert is pointed out, and an attempt is made to explain the difference upon the grounds of diversity in meteorological conditions as bearing on soil-moisture and evaporation.

The extended account embraces a year's observations of the meteorology, the topography and soils of an area of 2,000,000 acres, a somewhat detailed account of the plants and their distribution as related to the topography, together with observations upon the seasonal changes, and the adaptational characters in the vegetation which appear to be correlated with them.

The Presence and Absence Hypothesis: Dr. G. H. SHULL, Station for Experimental Evolution.

In explaining the behavior of what are now called Mendelian hybrids, Mendel assumed that pairs of antagonistic characters are represented by pairs of internal units, one member of each such pair of units coming from the one parent, the other from the other parent, and both existing side by side in the heterozygotes. De Vries laid great stress upon this conception in distinguishing between "varieties" and "species." This idea is perhaps yet the most commonly held, though it has recently become common to describe a Mendelian "pair" of characters in the terms of the presence and absence of a *single* character. There is no evidence of the existence of a pair of internal units or "allelomorphs" and the phenomena of incomplete dominance, reversal of dominance, etc., can be simply explained by the assumption that there is no paired condition of internal units. The dominance of the absence of a character over its presence is readily explained by analogy with many common chemical reactions, and while it may be assumed, as has been done by Bateson and Davenport, that what appears to be *absence* of a character may really be the *presence* of an inhibiting factor, this is not a necessary assumption. It can be shown that absence of an internal unit may be expected occasionally to dominate its presence.

Cultures of Uredineæ in 1908: Professor J. C. ARTHUR, Purdue University.

For the tenth consecutive season cultures of various species of rusts have been made from both resting or winter spores and active or summer spores. There were 204 collections with resting spores available, of which, however, only 105 collections were brought into germinating condition. Of those which could be made to germinate 248 sowings were made, representing about 44 different species. Of collections with active spores 73 sowings were made, representing about 16 species. The proportion of successful cultures equaled, or possibly exceeded, that of previous seasons. Some of the results of most general interest may be mentioned. For the first time in America the early or brown rust on rye was grown on *Anchusa*, being sown in July, and the similar rust on wheat failed to germinate so soon after maturity, seemingly settling the much-discussed identity of the so-called *Puccinia dispersa* of Europe and of America. Many trials with the rust on timothy, *P. phleipratensis*, failed to infect barberry plants, this agreeing with European studies. Telial connections were established for *Æcidium macrosporum* on *Smilax*, and the æcia on *Ranunculus*, *Cymbalaria* and *Aquilegia* sp. An unusually large addition to current information was secured regarding species of *Gymnosporangium*. The life-cycle was demonstrated for the first time for one species from the southern states, one species from the northern states and one species from the western states beyond the Rocky Mountains.

Dichotocladium, a New Genus of the Mucorinicæ: Professor A. F. BLAKESLEE, Connecticut Agricultural College.

The species (*D. stoloniferum*) which forms the type of this genus was found five years ago in Venezuela growing saprophytically on dung. It has the habit of growth of a *Chætocladium*, to which it is undoubtedly most nearly related. It differs from *Chætocladium* primarily in that the fertile branches are dichotomous, not in whorls, and the sterile ends are not bristle pointed.

The genus may be briefly characterized as follows: Vegetative hyphæ stout, distinct, continuous. Fertile hyphæ erect or creeping, stoloniferous, bearing one to several lateral bushy crowns of repeatedly forked hyphæ. Ultimate branches of crown, slender, projecting beyond its surface, or short, terminated by persistent swollen heads upon

which are borne solitary spores. Sexual condition heterothallic.

The Interpretation of pre-Persoonian Names, and their Bearing on the Selection of a Starting Point for Mycological Nomenclature: Dr. E. J. DURAND, Cornell University.

The paper discusses with quotations and examples the difficulties attending the interpretation of the species of pre-Persoonian authors because (1) the species were based entirely on external characters; (2) specific limits are now much more closely drawn than formerly; (3) microscopic characters, then ignored, are now regarded as the most important bases for generic and specific distinction, and (4) they as a rule preserved no specimens by which their names can be definitely determined. It is proposed, therefore, that the date 1753 be abandoned as the beginning of mycological nomenclature and a later one selected, so that these old names may be excluded. The considerations which should have weight in the selection of such a date are then taken up, and a brief history of systematic mycology given, with the discussion of several possible starting points. The conclusion is finally reached that Persoon's "Synopsis Methodica Fungorum," of 1801, be selected for the following reasons:

1. The genera and species described before the time of Persoon should be excluded from consideration because the majority of them can never be definitely and accurately identified.

2. Any publication in the modern period is too recent, the bulk of the systematic work having been done before it began.

3. Its date of publication is early enough to include a great majority of the published names of fungi, and nearly all of those which can be certainly fixed at the present time.

4. Its publication marks the beginning of the second important epoch in mycological history.

5. Its author was the originator of systematic mycology.

6. It can be used as well as any other work as the common point of departure for all groups of fungi.

7. It is a comprehensive work covering all groups of fungi, and summarizes what had been done before its time, so that it bears about the same relation to the classification of fungi that the "Species Plantarum" of Linnæus does to that of vascular plants.

8. Persoon's herbarium is in existence and is available for study, so that most of his names can be fixed with a degree of definiteness impossible for those before his time.

Adaptations in a Desert Lichen Flora: Professor BRUCE FINK, Miami University. By title.

Successful Inoculations with Peridermium: GEORGE GRANT HEDGCOCK, Bureau of Plant Industry.

Studies of the Potato Fungus, Phytophthora infestans: Professor L. R. JONES and Mr. N. J. GIDDINGS, University of Vermont.

Phytophthora infestans has been carried continuously in pure culture in the laboratories of the University of Vermont for four years. Starting with sterile blocks of raw potato, other culture media have been used with varying success, including raw and cooked potato and pumpkin; potato extract media, including juice from raw potato variously handled, potato broth, and broth with agar or gelatin; pumpkin agar; and several synthetic media solidified with agar.

Longevity.—Sealed gelatin cultures seven months old remained alive, but were slow in starting.

Noteworthy Morphological Characters Observed.—Haustoria-like branches in potato tissue as described by Delacroix. Abundant septation in old cultures. Apparent differentiation in some cases into two strains, the one exceeding the other in vegetative vigor. Oogonia-like bodies sparingly produced on certain media, frequent on others.

Concerning Infection and Disease Resistance.—Sporulation may occur in diseased tubers before digging and in storage. Infection occurs usually through eyes, but occasionally through wounds or lenticels. Wide differences occur between varieties (*e. g.*, Early Rose, vs. Irene) as to ease of leaf infection and subsequent rate of spread; leading to conclusion that disease resistance of leaves may reside in mesophyll as well as possibly in epidermal tissues.

Similar differences occur in the rate of development upon sterile blocks cut from the interior of potato tubers, *e. g.*, Ionia seedling *vs.* Irene. This difference is not due to the acid reaction of cell sap.

Artificial Cultures of Phytophthora with Special Reference to Oospores: Dr. G. P. CLINTON, Connecticut Agricultural Experiment Station.

In the 1905 Connecticut Agricultural Experiment Station Report the writer gave results of experiments with artificial cultures of *Phytophthora infestans*. The oospores, which are as yet unknown, did not develop in these. However, the oospores of *Phytophthora phaseoli*, described for the first time, readily developed in the cultures. The past fall specimens of the recently described

Phytophthora thalictri were found, but cultures were not attempted, since the host had no perennial parts from which infected tissue could be taken. However, the oospores, not reported before, were found in the leaves. To account for their absence in the potato mildew, especially in artificial cultures, the writer suggested that these fungi may have distinct sexual mycelia. This is indicated by observations that the antheridia and oogonia of the other two species seem to be borne on separate mycelial threads. Recently the writer again obtained pure growths of the lima bean mildew, from which several hundred cultures have been made in an attempt to solve this problem. Cultures from mycelial growths, possibly mixed, have so far always produced oospores. Petrie dish separation cultures are now being made to get cultures from single spores. If the theory is correct, these should produce no oospores.

Origin and Function of the Peridium of the Rusts: Professor E. W. OLIVE, South Dakota State College. By title.

Observations on the Relation of Wound Parasites to the Heartwood of the Affected Tree: Dr. P. SPAULDING, Bureau of Plant Industry.

While studying various wood-rotting fungi for the past few years there has been noted a very apparent relation of the so-called "wound parasites" to the heartwood of the diseased trees. A very striking instance of this was that of *Fomes ribis* occurring upon sassafras trees. In every case examined this fungus was found attacking the tree only in wounds where the heartwood was exposed by some injury, such as the breaking of a large branch, or the splitting of a branch from the main trunk. *Fomes igniarius*, as studied for the past four years, upon beech, has been found occurring in a similar manner. Hundreds of blazed beech trees have been examined, and in not a single instance was this fungus found growing upon these blazes in the sapwood. On the other hand, it was constantly found at wounds which extended into the heartwood. *Polystictus versicolor*, when attacking the heartwood of catalpa, occurs, growing into the stubs of dead branches. Such observations as have been thus far made upon *Fomes fraxinophilus* when attacking white ash show the same thing to be true, the attack practically always being made through dead stubs. Von Schrenk has also said that *Fomes rimosus* attacks the heartwood of black locust, either by entering through the dead stubs or through insect burrows. The sapwood of black locust is comparatively thin, and it is safe to accept his implied statement that heartwood must be exposed before this fungus attacks its host.

Further Studies of the Anthracnoses: Dr. C. L. SHEAR and Miss ANNA K. WOOD, Bureau of Plant Industry.

Twenty-three forms of so-called *Colletotrichum* and *Glœosporium* from the following hosts have been studied since the writers' previous paper was published: 1, *Camellia japonica;* 2, *Caryota rumphii;* 3, *Cinnamomum zeylanicum;* 4, *Citrullus vulgaris;* 5, *Citrus limonum;* 6, *Citrus decumana;* 7, *Citrus aurantium;* 8, *Coffea arabica;* 9, *Costus speciosa;* 10, *Cucurbita maxima;* 11, *Curculigo* sp.; 12, *Eriobotrya japonica;* 13, *Ficus longifolia;* 14, *Kentia* sp.; 15, *Lathyrus odoratus;* 16, *Ligustrum vulgare;* 17, *Maranta lineata;* 18, *Musa sapientum;* 19, *Persea gratissima;* 20, *Phormium tenax;* 21, *Piper macrophylla;* 22, *Pitcairnia corallina;* 23, *Psidium guajava;* 24, *Rubus occidentalis;* 25, *Thea bohea.*

Pure cultures made from conidia from hosts 6, 16, 19, 24 and 25 produced both conidia and ascospores and both these forms of fructification have been found on the host plants also. Cultures from conidia from hosts 3, 20 and 21 have produced both conidia and asci, but no ascogenous fructifications have been found on the host plants themselves. On hosts 1, 2, 5, 7, 8, 9, 11, 12, 13, 17, 22 and 23, both conidia and ascospores have been found. On hosts 4, 10, 14, 15 and 18 only conidia have been found and the cultures from the same hosts have produced only conidia.

Cultures from a single conidium taken from *Persea gratissima* carried through twenty-three generations have shown considerable variation in character of growth and development in different generations. Cultures from a single ascospore from the same source carried through seven generations have been quite uniform. The cultures from conidia usually produced an abundance of acervuli followed by perithecia. The cultures from ascospores produced no acervuli except a few very small ones in the first generation, but scattered conidia and an abundance of perithecia occurred in all. The ascospore cultures still produce conidia and the conidia cultures still produce asci.

No morphological characters either in cultures or under natural conditions have been found to be sufficiently constant to justify the segregation of species except perhaps in the case of the cotton anthracnose. The ripe rot fungus of the grape, *Glœosporium* (*Glomerella*) *rufomaculans*, represents fairly well the essential characters of all.

Cross inoculations from forms on fruits seem to indicate that the fungus may soon adapt itself to a different host and after a few generations develop about as readily on one fruit as another. All are perhaps only slightly specialized physiological forms of one omnivorous species.

A Bacterial Gall of the Daisy and its Relation to Gall Formations on Other Plants: Dr. C. O. Townsend, Bureau of Plant Industry.

In 1904 some Paris daisy plants affected with galls of different sizes were received from a commercial grower of this plant in New Jersey. Work upon the cause of these gall formations and their relation to similar abnormal growths upon other plants was undertaken by the writer in cooperation with Dr. Erwin F. Smith, in charge of the Laboratory of Plant Pathology. Much of the technical work in connection with the problems investigated has been performed by Miss Nellie A. Brown, scientific assistant in the Laboratory of Sugar Beet Investigations.

After repeated efforts an organism was isolated from the galls, which had the ability to induce the formation of new galls upon healthy plants when inoculated into the stems and branches or even into the leaves of healthy daisy plants. From these galls formed by inoculation, the organism has been isolated and the process of inoculation repeated until no doubt remains regarding the cause of the gall formations.

The organism which produces these growths is a short rod, motile, possessing from one to three polar flagella, non-gas forming, and does not cloud bouillon heavily. On agar plate cultures the colonies come up slowly, usually in from three to five days, at a temperature of 25° C. The surface colonies are translucent white, round, with entire margins, smooth and dense. The growth is viscid on agar streak cultures after three days. The organism blues litmus milk, does not liquefy gelatin and does not grow at blood temperature in either agar or bouillon cultures. It will grow slightly at a temperature below 0° C.

The daisy organism will produce galls upon a large number of other plants, including tomato, potato, tobacco, sugar beet, hop, carnation, grape, raspberry, peach and apple. This work has led to the isolation of pathogenic Schizomycetes from the galls of peach, hard gall of apple, hairy root of apple, hop, rose and chestnut. The organisms obtained from the galls of these different plants are cross inoculable and are very similar, if not identical in size, shape, structure and habits of growth on media with the organism from the daisy gall. Pure cultures of these organisms are now under investigation. The abnormal growths produced by inoculation with the organisms obtained from the galls of the plants mentioned are similar in many cases to those produced by the daisy organism upon those plants.

These investigations have left no doubt regarding the cause of the crown gall of the peach and at least some of the gall formations upon the apple and other economic plants.

Variation of Fungi Due to Environment: Professor F. L. Stevens and Mr. J. G. Hall, North Carolina College of Agriculture and Mechanic Arts.

The effect of different densities of colonies on a plate is reported for five species of fungi, some of which show an entire elimination of pycnidial formation and the production of spores without covering when plates are thickly sown.

The effects of different densities of mycelium upon zone formation are illustrated from *Ascochyta* and *Sclerotinia.*

The effects of chemicals as influencing the color, growth and character of several species of fungi are reported. The changes produced are often sufficient to shift the fungus from one order to another.

The effect of light upon growth, spore formation and zonation of colonies, of several species of fungi is reported.

Under the heading of "unknown factors" several changes of character which could not be attributed to environment are mentioned.

Duncan S. Johnson,
Secretary

Johns Hopkins University

THE ASSOCIATION OF AMERICAN GEOGRAPHERS

The fifth annual meeting was held in Baltimore, December 31, 1908, to January 2, 1909, under the presidency of Mr. G. K. Gilbert. Professor Albrecht Penck gave a lecture before the association at its opening session on Thursday evening, on "Man, Soil and Climate." Other features of the meeting were: the president's address by Mr. Gilbert, on the subject "Earthquake Forecasts," and a round table conference on "Geography for Secondary Schools," conducted by Professor R. E. Dodge. The conference was held informally in connection with a smoker at the Johns Hopkins Club on Friday evening. About thirty papers were read by members, representing meteorology and various phases of physiographic, biological, human and educational geography.

The important subject of cartography was also well represented. The officers for the ensuing year are:

President—W. M. Davis.

First Vice-president—L. A. Bauer.

Second Vice-president—E. R. Johnson.

Secretary—A. P. Brigham.

Treasurer—N. M. Fenneman.

Councilors—Cyrus C. Adams, R. S. Tarr and R. E. Dodge.

The place of the next meeting will be fixed by the council.

The following is a list of papers presented:

"Man, Soil and Climate" (public lecture), by Albrecht Penck.

"Earthquake Forecasts" (president's address), by G. K. Gilbert.

"Round Table Conference on Secondary Geography," by R. E. Dodge.

"Accumulation of Inherited Features in Shorelines of Evolution," by J. W. Goldthwaite.

"On the Elements of the Surface Sculptured by Glaciers," by W. H. Hobbs.

"Existing Glaciers of the Northern Hemisphere," by O. D. Von Engeln.

"The Topographic A B C of Land Form," by F. E. Matthes.

"How May the Teaching of Geography in Elementary Schools be Improved?" by C. T. McFarlane.

"Apparatus for Instruction in the Interpretation of Maps," by W. H. Hobbs.

"Some Practical Results of the Ninth International Geographical Congress," by H. G. Bryant.

"Three Gatherings of Geographic Interest," by A. P. Brigham.

"Status of the Magnetic Survey of the Earth," by L. A. Bauer.

"A Reconnaissance in the Arctic Slope of Alaska," by E. D. Leffingwell.

"The Climate of Cuba," by H. Gannett.

"The Temperature at Great Heights above the American Continent," by A. L. Rotch.

"The Climate of the Historic Past," by E. Huntington.

"Origin of Civilization through Intermittency of Climatic Factors," by J. R. Smith.

"The National Forest Policy," by H. A. Smith.

"Some Results of the Recent Census in Cuba," by H. Gannett.

"The Anthropography of Some Great Cities," by Mark Jefferson.

"The Capacity of the United States for Population," by A. P. Brigham.

"Geographical and other Influences affecting the Pottery Industry of Trenton, N. J.," by R. H. Whitbeck.

"Geographical Influences in the Development of Ohio," by F. Carney.

"Trade Routes in the Economic Geography of Bolivia," by I. Bowman.

"The Influence of the Precious Metals on American Exploration, Discovery, Conquest and Possession," by G. D. Hubbard.

"The Stream Robbery on which the Belle Fourche Reclamation Project is Based," by N. H. Darton.

"A Remarkable Glacial River and its Modern Representative," by F. Taylor.

"Delta Form and Structure of the Thames River Terraces, Connecticut," by F. P. Gulliver.

"The Requisites of a School Wall Map," by J. P. Goode.

A. P. BRIGHAM,
Secretary

THE SOCIETY FOR HORTICULTURAL SCIENCE

AT a business meeting of the society held in Baltimore, December 31, 1908, several important questions were discussed. The committee appointed at the Jamestown meeting to interview the Secretary of Agriculture with reference to having the annual reports of the society published by the Department of Agriculture reported that they had interviewed Dr. B. T. Galloway, who represented the Secretary of Agriculture in this matter, and that it was almost certain that the department would publish the reports, provided the following amendments were adopted by the society:

"That the association shall be known as the American Association of Official Horticulturists, the object of which is to promote the science of horticulture, and that any person connected with a state or federal experiment station or with the U. S. Department of Agriculture or its territorial stations, or with any other institution in the United States or Canada, who is engaged in the teaching of horticulture, or in experiments bearing upon it, may become a member of the association and shall be entitled to vote on the conditions which are embodied in the present constitution. Furthermore, that all horticulturists in the United States and in Canada, or in any other country engaged in the teaching or investigation of horticulture, may become associate members of the association under the same conditions that govern the admission of members and shall have all the privileges of members except the right to vote and hold office."

These amendments were discussed and were satisfactory to the members present, but the amendments could not be adopted, since the by-laws require that amendments presented at one meeting can not be adopted before the next annual meeting.

It was the sentiment of the society to affiliate with the National Association for the Advancement of Agricultural Science when the organization of the latter society was sufficiently advanced to make this possible and desirable.

The society voted to fix a price of one dollar per copy for its annual reports to new members and to educational institutions, and a price of two dollars per copy to non-members.

The officers and members of committees for 1908 were reelected for 1909.

C. P. Close,
Secretary-treasurer

SOCIETIES AND ACADEMIES

THE KANSAS ACADEMY OF SCIENCE

The forty-first annual meeting of the academy was held in Topeka during holiday week, and was of unusual interest both in the quality and number of papers presented for discussion. The retiring president, E. Haworth, chose for the subject of his address "The Life History of a River," and discussed the cause of floods, and the means of controlling these destructive agencies. A. J. Smith told how the city of Emporia is securing a good water supply from the underflow of the Neosho river. The pure food and drugs law called forth several important papers from Professors Bailey, Sayre, Willard, Ziefle and Jackson. The biologists reported additions made in the past year to the lists of birds, mammals and insects. Professor Dyche contributed important notes of his experience in preserving the skins of mammals. Dr. Williston sent a paper on the "Skull Structure of Diplocaulus" with restoration, and C. H. Sternberg, the enthusiastic fossil hunter, gave an account of his last summer's finds in the Laramie beds of Wyoming.

One evening was given to memorial exercises in honor of the late Dr. Francis Huntington Snow, one of the founders of this academy, and for more than forty years connected with the University of Kansas, where he held the office of chancellor for twelve years. One of his earliest colleagues, Professor E. Miller, gave a memorial address, and other members spoke of him as a collector, teacher and contributor to scientific discovery. Another evening session, held in Washburn College, was in part a social occasion, and was otherwise made interesting by Professor Edmondson giving some excellent stereopticon views illustrating an account of his last summer's trip to Tahiti. Professor Parker gave some fine specimens of bird photography, and Professor Sternberg exhibited some good views of the Laramie beds of Wyoming.

The officers elected for the ensuing year were as follows:

President—F. B. Dains, Topeka.

First Vice-president—J. M. McWharf, Ottawa.

Second Vice-president—A. J. Smith, Emporia.

Treasurer—F. W. Bushong, Lawrence.

Secretary—J. T. Lovewell, Topeka.

Ottawa was selected as place for the next annual meeting.

The following papers were presented:

Papers, illustrated by stereopticon:

"Some Glimpses of Tahiti," by C. F. Edmondson.

"Notes on Photography of Wild Birds," by J. B. Parker.

Chemical and Physical Papers

"Resins in Vanilla Extract," by H. L. Jackson.

"An Examination of Apparatus for a Simple Determination of Carbon Dioxid in Air," by E. H. S. Bailey.

"Sulphites as Preservatives," by Edith A. Goodwin and E. H. S. Bailey.

"The Character of the Mid-continent Petroleum," by F. W. Bushong.

"Fluctuations in the Mineral Contents of the Kaw River," by F. W. Bushong and A. J. Weith.

"The Importance of Pharmacological Methods in Drug Assay," by Adolph Ziefle.

"Suggested Legislation in Regard to the Selling of Cocaine," by H. W. Emerson.

"Enameling Steel," by R. D. Landrum.

"The Relation of Manganese to the Corrosion of Iron," by H. P. Cady.

"Progress of Work in Drug Analysis under Pure Food and Drugs Law," by L. E. Sayre.

"Comments on Analysis of Spices," by L. E. Sayre.

"Study of the Cause of Coal-mine Explosions," by E. Haworth and C. M. Young.

"The Medullary Ray as an Element of Strength in Structural Timber," by F. E. Jones.

"On some Methylene Derivatives," by F. B. Dains.

"Recent Investigations of the Properties of Steam," by P. F. Walker.

"Pelton Water-wheel Test made at the University of Wisconsin in the Summer of 1908," by Chas. I. Corp.

"Some Notes on the Steel-hardening Minerals," by J. C. Cooper.

"A Speculation in Crystallography," by J. E. Todd.

"Economy of Heat in Cooking," by J. T. Lovewell.

"Some Difficulties in Testing Food for Sulphites," by J. T. Willard and C. A. A. Utt.

Geological Papers

"Some Notes on the Olympic Peninsula, Washington," by A. B. Reagan.

"The Formations of the Marion Stage of the Permian," by J. W. Beede.

"Why the Southern Hemisphere is the Principal Water Hemisphere and the Northern the Principal Land Hemisphere," by J. J. Jewett.

"The Drainage of the Kansas Ice Sheet," by J. E. Todd.

"Expedition to the Laramie Beds of Converse County, Wyoming, 1908," by C. H. Sternberg.

"A Study of Certain Features of the Lawrence Shales," by J. A. Yates.

"The Extremities and Skull Structure of Diplocaulus, with Restoration," by S. W. Williston.

"The Skull Structure of *Diplocaulus magnicornis* Cope," by R. L. Moodie.

"Carboniferous Quadrupeds of Kansas," by R. L. Moodie.

Biological Papers

"A New Bird for the Kansas List, taken at Lawrence," by L. L. Dyche.

"Supplementary Additions to the List of Kansas Diptera," by E. S. Tucker.

"Weismann's Germ Plasm Hypothesis Untenable," by L. C. Wooster.

"Notes on a Captive Heloderma," by B. B. Smyth.

"The Birds of the Olympic Peninsula, Washington," by A. B. Reagan.

"Trees and Shrubs of Kansas," B. B. Smyth.

"Distribution, Natural Enemies and Breeding Habits of the Kansas Pocket Gophers," by T. H. Scheffer.

"The Poison Glands of a Rattlesnake during the Period of Hibernation," by L. L. Dyche.

"Notes on Bats," by Lumina C. R. Smyth.

"The Latest Tests for Gas-forming Bacteria in Water," by W. B. Wilson.

"Additions to the List of Kansas Coleoptera," by W. Knaus.

"Some Notes on Kansas Coleoptera," by W. Knaus.

"Note on the Northern Distribution of *Amblychila cylindriformis* Say," by W. Knaus.

"Kansas Coleoptera of the Families Colydiidæ, Cucujidæ, Cryptophagidæ, Mycetophagidæ, Dermestidæ, Histeridæ, Nitidulidæ, Lathridiidæ, Trogositidæ, Parnidæ, Heteroceridæ, Dascyllidæ and Rhipiceridæ," by W. Knaus.

"Intercellular Spaces in Plants," by L. A. Kenoyer.

"Some Notes on the Common Mole," by T. H. Scheffer.

"Coccidæ of Kansas," by G. A. Dean.

"Notes on Kansas Mammals," by D. E. Lantz.

"Some Interrelations of Protozoa," by C. H. Edmondson.

"List of Insect Types and Co-types in the Collection of the University of Kansas," by C. H. Withington.

"Habits of Parasitic Hymenoptera, II.," by C. H. Withington.

Miscellaneous Papers

"The Importance of having Standard Weights and Measures," by E. F. Stimpson.

"Temporary Industrial Fellowships," by R. E. Duncan.

"Railway Rates from an Engineering Standpoint," by B. F. Dalton.

"The Centenary of Charles Darwin," by A. H. Thompson.

"Estimation of the Relative Value of Feeds," by E. B. Cowgill.

"Further Notes on the Influence of Heredity in Stock-breeding," by I. D. Graham.

"Ups and Downs of our Homes from an Architect's Point of View," by N. P. Nielsen.

"Some Glimpses of Tahiti," by C. H. Edmondson.

"Cancer," by J. M. McWharf.

"The Cause and Prevention of Tuberculosis," by S. C. Emley.

"An Improved Water-supply for the City of Emporia," by A. J. Smith.

"A Speculation in Crystallography," by J. E. Todd.

"Indian Remains in the Canadian River Valley," by T. L. Eyerly.

"Notes on Photography of Wild Birds," by J. B. Parker.

"A New Geometrical Figure and its Possible Application," by E. C. Warfel.

"Preliminary Note on Measuring the Speed of Photographic Shutters," by H. I. Woods.

"Views and Notes from Utah," by I. D. Cardiff.

THE ASSOCIATION OF TEACHERS OF MATHEMATICS IN THE MIDDLE STATES AND MARYLAND

THE eleventh meeting of the Association of

Teachers of Mathematics in the Middle States and Maryland was held at Franklin and Marshall College, Lancaster, Pa., on November 28. After the address of welcome by President Stahr, the following papers were read:

"Training versus Facts," by William Henry Metzler, Syracuse University.

"Elementary Logic as a Basis for Plane Geometry," by Eugene Randolph Smith, Polytechnic Preparatory School, Brooklyn, N. Y.

"The International Commission on the Teaching of Mathematics," by David Eugene Smith, Teachers College, New York City.

"Checks, Their Use and Abuse, by William E. Breckenridge, Stuyvesant High School, New York City.

"Historical Mathematical Material from the East," by Miss Bertha L. Broomell, Teachers College, New York City.

The annual election of officers was held; the officers elected follow:

President—William Henry Maltbie, Woman's College, Baltimore, Md.

Vice-president—William E. Breckenridge, Stuyvesant High School, New York City.

Secretary—Eugene Randolph Smith, Polytechnic Preparatory School, Brooklyn, N. Y.

Treasurer—Emma Hazleton Carroll, High School for Girls, Philadelphia, Pa.

Members of the Council—William H. Metzler, Syracuse University; Susan C. Lodge, Philadelphia Collegiate Institute for Girls.

The council appointed ten delegates to the American Federation, a committee on publication, composed of William H. Metzler, *chairman*, Eugene R. Smith, Jonathan T. Rorer, and a committee on mathematical work in continuation schools, having as chairman William E. Breckenridge.

The following amendment to the constitution was recommended by the council:

Paragraph I. of Section II., to read:

"The annual meeting shall be held at a time and place to be selected by the council."

The spring meeting of the association will be held at Syracuse University on Easter Saturday.

EUGENE R. SMITH,
Secretary.

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 452d meeting was held January 9, 1909, with President Palmer in the chair. The following papers were presented:

The Type of the Genus Cactus: J. N. ROSE.

Present Status of the Cotton Boll Weevil: W. D. HUNTER.

The speaker discussed especially two of the most important biological questions that have arisen on account of the invasion of the cotton belt by the boll weevil. These questions are, first, the extent to which the insect is capable of adapting itself to the conditions of this country which are radically different from those of the original home, and, second, the effect on the indigenous fauna in this country.

The wide variation in rainfall, geological formation and other respects in areas that have been invaded was described. The rainfall varies from 12 to 50 inches; the elevation from sea level to 2,500 feet, the absolute minimum temperature from $-20°$ F. to $+20°$ F. These variations have caused distinct agricultural provinces to arise, and, indeed, have been so important that they have had an effect towards establishing races of men. The weevil has maintained itself in all this region, but has been most affected by dryness. The cotton plant has an advantage over the weevil in this respect, which indicates that cotton production in western Texas is certain to increase enormously. It is not too much to suppose that the increase in that quarter will offset the falling off in other parts of the belt.

The boll weevil has had very important effects upon the local insect fauna. A number of parasitic and predaceous insects have changed from the original indigenous hosts to the immigrant. Eight predaceous forms attack the adult, 15 similar forms attack the larva, 24 hymenopterous parasites also attack the larva. These parasites also attack 48 species of weevils. The boll weevil complex, therefore, comprises 49 weevils which feed upon 95 plants and 97 insect enemies of these weevils. The interrelationship is so intimate that a factor that will affect any one of the 95 plants in the complex may react upon the boll weevil.

It was pointed out that the boll weevil problem has recently taken on entirely new aspects in the Mississippi Valley. The heavy precipitation, abundance of timber and poor drainage have caused the problem to be much more serious than it was in Texas. This has been shown during the season of 1908 by a great falling off in the production of cotton in Louisiana and the infested portion of Mississippi.

The best hope for the future is in the insect enemies of the weevil. The climatic conditions in Texas that have checked the weevil have also checked the parasites. With the removal of these

checks in the Mississippi Valley it is supposed that the efficiency of the parasites will be proportionately much greater than it has been elsewhere. Practical experiments have been conducted which show that the artificial introduction of parasites that have adopted themselves to the boll weevil in Texas is a hopeful line of assistance to the cotton planter.

Investigations of Toxoptera graminum and its Parasites: by F. M. WEBSTER.

This is a species of aphis which on account of its depredations has come to be known in the grain-growing sections of the southeast and southwest as the green bug. Invasions occur at irregular intervals both in this country and in Europe, when it breeds in immense swarms, not only proving exceedingly destructive, but the winged insects flying or drifting about in clouds, sometimes becoming troublesome to people.

It is known to occur in southern Europe, Hungary, Belgium, in Siberia and in the Orange River Colony, South Africa. In the United States it extends from Mexico and the Gulf northward to Canada, excepting in the central New England states. It also occurs on the Pacific coast. It inhabits elevations of only a few feet above the sea level to the high plateaus of the west at an elevation of eight thousand feet.

While preferring grain, especially oats, it breeds on the following grasses: *Poa pratensis*, which is a common food plant all over the north; *Alopecurus geniculatus*, *Agropyron occidentalis* and *Hordeum pusillum* in Oklahoma, Kansas and Colorado; *Agropyron tenerum*, *Bromus portei*, *Elymus striatus*, *Hordeum cæspitosum*, *Polypogon monspeliensis* and *Stipa vividula* in New Mexico; *Distichlis spicata* and *Hordeum jubatum* in Montana; *Setaria glauca* in Indiana; and *Dactylis glomeratus* in the northern states and Virginia. In the northern section of the country its principal food plant seems to be blue grass.

Its destructive outbreaks in the United States seem to be regulated by the mild winters and cold springs, not so much on account of the influence of temperature upon the insect itself as upon its principal parasite *Lysiphlebus tritici* which ordinarily holds it in check. Wintering over in the north in the egg stage; in the central portion of the country as far south at least as Tennessee and southern Kansas, both in the egg and as viviparous females; and as the male and sexual female of *Toxoptera graminum* may also occur in the spring, it seems quite possible that in the far south, in the region of the Rio Grande River, this aphid may pass the dry season instead of the winter in the egg stage, although this has not yet been proved. While the egg-laying female is quite distinct from the viviparous female, individuals frequently occur that are both oviparous and viviparous. The oviparous female produces very few eggs, probably not to exceed a half dozen. The young hatching from these eggs are all of them viviparous females and in the north these continue to remain viviparous until fall and sometimes even through the entire winter.

The principal parasite, *Lysiphlebus tritici*, is parthenogenetic, the offspring of virgin females being usually all males. Occasionally there are females, and these being kept virgin have produced an occasional female to the third generation from the mated female. These parasites deposit their eggs singly in the body of the *Toxoptera*, and the larva when it becomes full grown lines the now empty body of its host with silken threads and attaches the cocoon to the leaf of the plant. These cocoons cause the body of the host to assume a rotund appearance and brownish color and where the insect is excessively abundant and the parasites increasing rapidly these brown bodies become so thick as to give a field of wheat or oats observed at a distance a brownish tinge.

Other insect enemies are the lady beetles, Coccinellidæ, a minute *Aphelinus* and probably a larva of a small fly belonging to the genus *Leucopsis*.

M. C. MARSH,
Recording Secretary

THE NEW YORK ACADEMY OF SCIENCES. SECTION OF ASTRONOMY, PHYSICS AND CHEMISTRY

AT a meeting held at the Museum of Natural History, on Monday, January 18, Dr. O. W. Willcox presented a paper entitled "Cylindrogenite, a Possible Representative of a Cylindrical (Non-Hauyan) Order of Crystals," in which he described a remarkable new form of limonite which occurs in the Red Bank sand of the Upper Cretaceous of New Jersey. The limonite, var. Cylindrogenite, occurs normally as perfect cylinders (which may be either hollow or solid), terminated at either end by a cone or a hemisphere. Two or more cylinders frequently intergrow, forming aggregates in which each cylinder preserves the alignment of its own axis; a number of such aggregates and also a number of photographs were exhibited. A most careful and painstaking study extending over more than three years having failed to suggest any other possible origin for these

objects, Dr. Willcox makes the novel suggestion that they are representatives of a non-Hauyan order of crystals, which he proposes to call the cylindrical system, as distinguished from the cubical and other systems of the Hauyan order. The speaker pointed out that there are no *a priori* reasons for regarding the Hauyan order as the sole mode of expression of crystalline nature; he knew of no reason why nature should be regarded as impotent to fashion a crystal after the form of a cylinder as well as after the form of a cube. As the facts indicate that the cylinders were formed by molecules of dissolved matter in the act of separating from solution to constitute the solid phase, and in so doing assumed a geometrical form of consistent regularity, they are as much entitled to be regarded as crystals as are the cubes which are formed when sodium chloride separates from solution. The cylinder being a geometrical form of higher symmetry than the cube, the absence of distinguishing crystallographic characters as seen under the microscope would be accounted for; and hence a crystallographic investigation shows nothing out of the ordinary.

Professor D. W. Hering read a paper on "Orthopedic Photography, Notes on the Rectification of Distorted Pictures." The paper discussed the defects common in kodak pictures, which arise from badly timed exposure in various conditions of light, followed by development of a whole set of films at once, resulting in excessive inequalities of light and shade. In printing from such a negative, if the source of light is small, as a gas flame or incandescent bulb, these faults can be corrected to a great extent by holding the printing frame in such a position that the distance to different parts of the negative gives different intensity of illumination, and the subsequent development of the print is normal. It also considered the distortion of pictures arising from using a short focus lens, and holding the camera at an awkward angle, as, for instance, pointing it upward or downward at a considerable inclination. By rephotographing the distorted picture, placing it before the camera at an angle to the axis of the lens, a counter distortion is effected which under judicious management rectifies the picture and sometimes improves it. The discussion was directed entirely to correction of defects by physical treatment instead of chemical. Numerous lantern slides illustrated the various stages of these corrective processes.

Professor W. Campbell read "Some Notes on Western Smelters." A series of lantern slides intended to show the evolution of the western lead smelters on account of changes in conditions and improvements in practise. A photograph of the Globe Smelter, Denver, showed the location of the main buildings. A plan of the plant showed the receiving tracks, bins for fuel, fluxes and ore, the beds, the various roasters, the blast-furnaces and the matte settling reverberatories, flues, baghouse, the old refinery, etc. A tree of smelting showed the course of the materials. Other slides showed the handling of raw materials, the methods of bedding at different plants; of roasting, briquetting of fines; the blast-furnace, types, methods of charging, tapping of lead, of matte and slag, the separation of the same, handling of foul slag, etc. Level versus sloping sites shown by contrasting photographs of the Murray plant with those of the Leadville, Eilers, Pueblo, etc. Two copper smelters were described: the Highland Boy at Bingham, with 20 McDougall and 3 Wethey roasters, 9 reverberatory smelters and 4 converter stands; the Garfield plant, with 2 blast-furnaces and 3 reverberatory smelters, 4 converter stands, the oxide and sulphide mills, beds, roasters, the Huntington-Herberlein equipment for roasting fine concentrates, etc.

W. CAMPBELL,
Secretary

COLUMBIA UNIVERSITY,
NEW YORK CITY

SECTION OF GEOLOGY AND MINERALOGY

AT the regular meeting of December 7, 1908, the evening was devoted to the conditions and problems that have developed by tunneling the Hudson River gorge. Many engineers directly concerned in these enterprises or related ones were present and joined in the discussion.

The following three papers were read summarizing the accumulated data and suggesting the history and structure indicated by them.

"Our Knowledge of the Filled Channel of the Hudson in the Highlands and the Submerged Gorge on the Continental Shelf," by Professor J. F. Kemp. It was shown that the depth now known, over 650 feet, at Storm King Mountain, 50 miles above New York, is greater than at any other point in the whole drainage system except far out on the continental shelf.

"A Summary of an Investigation into the Structural Geology of Southern Manhattan and the Condition of the East River Channel," by Dr. Charles P. Berkey. The results of identification of material recovered from 300 drill borings in southern Manhattan and the adjacent channels

were shown. In this area there are no rock outcrops and nothing is known of bed rock type or condition except what can be determined in this way. It is now certain, however, that the southern end of the island is not wholly underlain by Manhattan schist as formerly mapped, but that the east side is made up of the usual succession of folded Fordham gneiss, Inwood limestone and Manhattan schist.

"Some of the Latest Results of Explorations in the Hudson River at New York City," by Dr. E. O. Hovey. Borings made by the Pennsylvania Tunnel Company across the Hudson on the line of Thirty-second Street were shown and interpreted. Bed rock has been penetrated at three points in the gorge proper. All are approximately 300 feet deep to rock. But since these holes are nearly 1,200 feet apart, the interesting question of a possible narrow inner gorge still remains. Seeing that the proved depth in the Highlands is at least 350 feet deeper than is yet found at New York City, the Hudson problem may still be considered an open one.

CHARLES P. BERKEY,
Secretary of Section

THE AMERICAN CHEMICAL SOCIETY
NORTHEASTERN SECTION

THE eighty-eighth regular meeting of the section was held on December 18, at the Chemical Laboratory of Harvard College, Cambridge. An address upon "The Systematic Relations of the Compressibilities of Elements and Simple Compounds" was delivered by Professor Theodore W. Richards, of Harvard University. The speaker called attention to probable relationships between the compressibilities of the elements, the changes of atomic volumes upon the formation of compounds, and the chemical affinities as measured by heats of reaction. After pointing out the lack of reliable data concerning the compressibility of substances, he described the apparatus in use by himself for the determination of this constant and stated that values for the compressibility of thirty-five elements and a number of compounds had already been obtained. It was shown that the compressibility is a periodic function of the elements and that the relationships with atomic volumes and heats of reaction are in remarkable agreement with the predictions. Some striking relationships among organic compounds were cited and it was stated that further work is being done upon the study of isomers.

Professor Bertram B. Boltwood, of Yale University, briefly described the recent work of Professor Rutherford upon the "α rays."

THE eighty-ninth regular meeting of the section was held at the Massachusetts Institute of Technology on January 22. The following papers were presented: "Fundamental Principles underlying the Decay of Structural Materials," by Professor W. H. Walker, of the Massachusetts Institute of Technology, a concise statement of the electrolytic theory of the corrosion of iron; "Protective Coatings for the Conservation of Structural Materials," by Mr. Robert S. Perry, president of the scientific section of the Paint Manufacture Association of the United States, an account of work being done in testing the porosity and elastic strength of paint skins and the inhibitive or stimulative effect of certain pigments on the rate of corrosion of metals.

KENNETH L. MARK,
Secretary

THE SCIENTIFIC ASSOCIATION OF JOHNS HOPKINS UNIVERSITY

THE association held its monthly meeting January 13, when it was addressed by Professors J. M. Baldwin and J. B. Whitehead.

Professor Baldwin spoke upon the subject of "Genetic Science," classifying sciences as genetic or agenetic. He showed the ground for the distinction between them to be that they are qualitative and quantitative, respectively.

The limitations of quantitative science were pointed out while recent advances in the scientific and philosophical theory of genetic science were discussed. Quantity and quality both represent special points of view, each requiring a certain abstraction and limitation with respect to the actual events of nature. It is the task of philosophy to affect the synthesis which will not disqualify either.

Professor Whitehead discussed the problem of the "Electrification of Steam Railways." Steam railways are being transformed and operated electrically in tunnels in order to secure freedom from gases due to combustion; in terminals to increase traffic capacity, and on through service in order to lessen cost of operation. Coal consumption and cost of repairs are lessened. It was shown that the electrification of all the steam railways of the country would lessen the total consumption of coal of the country about 7 per cent.

C. K. SWARTZ,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 19, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

RECENT PROGRESS IN AERONAUTICS[1]

THERE are two general classes of vehicles of the air, (*a*) those which depend for their support upon the buoyancy of some gas lighter than air, and (*b*) those which depend for such support upon the dynamic reaction of the air itself. These classes are designated:

(*a*) Lighter-than-air types:
Free balloons, dirigible balloons or airships.
(*b*) Heavier-than-air types:
Aeroplanes, orthopters, helicopters, etc.

It should be remarked, however, that these two general classes exhibit a growing tendency to overlap each other. For example, the latest dirigible balloons are partly operated by means of aeroplane surfaces, and are also often balanced so as to be slightly heavier than the air in which they move, employing the propeller thrust and rudder surfaces to control the altitude.

I. AEROSTATION

Captive and free balloons, with the necessary apparatus and devices for operating the same, have been for many years considered an essential part of the military establishment of every first-class power. They played a conspicuous part in the siege of Paris, and were often valuable in our own civil war. The construction and operation of aerostats are too well understood to need further attention here.

Although many aerodynamic data are needed for the proper design of a dirigible

[1] Abstract of an address before Section D—Mechanical Science and Engineering—American Association for the Advancement of Science, Baltimore, 1908.

airship, yet the experience already available in the construction and performance of such ships built on different plans is sufficient to enable the engineer to proceed with the design of a dirigible balloon to accomplish definite results along fairly accurate lines. In the case of this class of lighter-than-air ships the following general equation obtains:

$$W - w = V(\sigma - \sigma/n)$$

where

W = weight of balloon, envelope, car and aeronauts,
V = volume of balloon,
σ = density of the air,
n = density of air as compared with gas,
w = weight of air displaced by car and aeronauts and envelope of balloon.

If we call the weight of the gas in the balloon M, then we can write this equation in the following manner:

$$W + M = w + nM,$$

from which we find that

$$M = (W - w/n - 1)$$

and

$$V = [(W - w)/\sigma]\ [n/(n - 1)],$$

thus obtaining the volume of gas required. If the volume of the gas-bag, car, aeronauts, etc. $= v$, then $w = v\sigma$; so that the preceding equation may be written

$$V = [(W - v\sigma)/\sigma]\ [n/(n - 1)].$$

Thus far, certainly, no dirigible balloon has ever been developed which has attained an independent speed greater than forty miles per hour. It will readily be admitted that an airship so designed as to reach a speed of fifty or sixty miles per hour would be regarded as a most decided step forward in the art, since this difference of velocity is just the increment needed to place such craft on a practical basis capable of maneuvering in the air in all ordinary weather. This advancement, although requiring much consideration, would fully compensate in practical results.

The first point to be decided upon in the design of an airship is the method of maintaining the shape of the gas-bag against the pressure encountered at the maximum velocity to be attained. There are two schools of design in this respect, each having its adherents. One maintains the shape of the gas-bag by a rigid interior frame, and the other by means of the internal pressure of the gas itself.

Upon the selection of the type depends to a large extent the particular shape of the envelope. If the envelope is to maintain its shape by interior pressure of gas, evidently it must be so designed that the maximum pressure of the air developed at the speed contemplated shall not be sufficient to cause deformation of any part of the envelope. This can be effected only by making the uniform internal pressure at least equal to the maximum external pressure. Since the maximum external pressure occurs over the prow of the airship, this, evidently, is the particular part which must receive most careful attention with this system.

The desirable shape of head would evidently be one where the distribution of external pressure due to air resistance at the velocity used is uniform. In addition to preventing deformation of the gas-bag, a prime requisite also is that the shape shall be such that the total resistance, comprising head resistance and skin-friction, shall be a minimum for a given displacement and velocity.

This immediately forces the question of the law of resistance of the air. On this subject there are numerous aerodynamic data for low velocities, and also for very high velocities, but such data are incomplete for the range of velocities here considered.

In fact, the law of resistance of the air

for surfaces of revolution as experimentally determined, is known to vary not with any constant power of the velocity, but by a range of exponents from the first to the cube, if not higher. For example, in the enormous velocities attained by modern artillery, where bodies weighing a ton or more are hurled through the air at 2,000 feet per second, it is known that the physical phenomena become entirely different in nature from those found when dealing with moderate velocities such as are met in transportation devices.

If the rigid system be employed where an internal frame prevents deformation of the envelope, the stresses due to external pressure are taken up by the framework itself, and the gas required for flotation is usually contained in several separate receptacles or ballonets similar to compartments employed in ships. In this system, therefore, we are concerned only in securing such a shape of the rigid frame as will fulfill the condition of minimum total resistance for a given displacement and velocity.

Once the shape of the bag is determined from the considerations already enumerated, the dimensions become immediately fixed when the tonnage is assumed, or conversely, if any linear dimension is assigned the tonnage is thereby determined.

In addition to the two general systems above considered, there are various types involving some of the principles of each, which are classed in general as semi-rigid systems. Such systems usually comprise a rigid frame, to which is attached the gas-bag above, and the load below.

The next step is one of structural design along strictly engineering lines. The aerodynamic features of airship construction may be considered under the heads: (*a*) static balance, (*b*) dynamic balance, (*c*) stability, (*d*) natural period and oscillation.

Static Balance.—The dimensions of the gas-bag being determined, the lift of each transverse segment thereof is immediately known, and the design of the frame may proceed by approximate trial and correction as in other structural work. The weight of each segment of the envelope itself is readily computed, which, added to the corresponding segment of the frame, gives the total weight of each segment, and this total subtracted from the lift of each segment gives the net lift for that complete segment. From the magnitude and position of these net forces the position of the resultant lift is known, and this determines the vertical line through the center of gravity. Such procedure evidently insures static balance of the machine as a whole, and an approximate distribution of the load.

Dynamic Balance.—The dynamic balance must also be carefully considered; and here a difficulty has been experienced on account of the inability to place the resultant thrust coincident with the line of resistance of the ship as a whole. Heretofore, it has been customary to balance the thrust-resistance couple by means of suitable horizontal rudders or planes, so situated and at such angles that the resultant moment of the system should be zero at uniform speeds of travel, though not necessarily zero for accelerated motion.

If, however, the line of thrust be made coincident with the line of resistance, the disturbing moment in question will be eliminated at uniform speeds. If, furthermore, the center of mass be located on the line of thrust and sufficiently forward to form a righting couple with the resistance when the wind suddenly veers, the evil effects of a disturbing moment will be obviated for variable as well as for constant speeds. The ship is then dynamically balanced.

This, of course, requires that the form of hull be such that a quartering wind shall exert a force passing to the rear of the

center of mass. To illustrate, a good example of dynamic balance is found in a submarine torpedo, or a fish.

Stability.—The foregoing adjustments still allow the center of mass to be placed below the center of buoyancy. This is a provision that is important in aeronautics as well as in marine architecture; indeed, it is the only practical provision for keeping an even keel and preventing heeling when the ship is at rest, or simply drifting with the wind. If the center of gravity be well below the center of buoyancy, the vessel is proportionately stable, but, of course, the stability is pendular, and may admit of considerable rolling and pitching due to shifting loads, sudden gusts of wind, etc., unless special devices be used to dampen or prevent these effects.

Natural Period and Oscillations.—It may happen also that the equilibrium of the ship is disturbed by periodic forces whose periods are simply related to the natural period of the ship itself. In this case the oscillations will be cumulative and may become very large. Such effects are well known to marine engineers, and may be treated as in ordinary ship design.

II. AVIATION

This division comprises all those forms of heavier-than-air flying-machines which depend for their support upon the dynamic reaction of the atmosphere. There are several subdivisions of this class dependent upon the particular principle of operation. Among these may be mentioned the aeroplane, orthopter, helicopter, etc. The only one of these that has been sufficiently developed at present to carry a man in practical flight is the aeroplane. There have been a large number of types of aeroplanes tested with more or less success and of these the following are selected for illustration.

The design of an aeroplane may be considered under the heads of support, resistance and propulsion, stability and control.

Support.—In this class of flying-machines, since the buoyancy is practically insignificant, support must be obtained from the dynamic reaction of the atmosphere itself. In its simplest form, an aeroplane may be considered as a single plane surface moving through the air. The law of pressure on such a surface has been determined and may be expressed as follows:

$$P = 2k\sigma A V^2 \sin a,$$

in which P is the normal pressure upon the plane, k is a constant of figure, σ the density of the air, A is the area of the plane, V the relative velocity of translation of the plane through the air, and a the angle of flight.

This is the form taken by Duchemin's formula for small angles of flight such as are usually employed in practise. The equation shows that the upward pressure on the plane varies directly with the area of the plane, with the sine of the angle of flight, with the density of the air, and also with the square of the velocity of translation.

It is evident that the total upward pressure developed must be at least equal to the weight of the plane and its load, in order to support the system. If P is greater than the weight the machine will ascend, if less, it will descend.

The constant k depends only upon the shape and aspect of the plane, and should be determined by experiment. For example, with a plane 1 foot square $k\sigma = 0.00167$, as determined by Langley, when P is expressed in pounds per square foot, and V in feet per second.

The first equation may be written

$$AV^2 = P/2k\sigma \sin a.$$

If P and a are kept constant then the equation has the form

$$AV^2 = \text{constant}.$$

An interpretation of the second equation reveals interesting relations. The supporting area varies inversely as the square of the velocity. For example, in the Wright aeroplane, the supporting area at 40 miles per hour is 500 square feet, while if the speed is increased to 60 miles per hour this area need be only $500/1.5^2 = 222$ square feet, or less than one half of its present size. At 80 miles per hour the area would be reduced to 125 square feet, and at 100 miles per hour only 80 square feet of supporting area is required. These relations are conveniently exhibited graphically.

It thus appears that if the angle of flight be kept constant in the Wright aeroplane, while the speed is increased to one hundred miles per hour, we may picture a machine which has a total supporting area of 80 square feet, or a double surface each measuring about $2\frac{1}{2}$ by 16 feet, or 4 by 10 feet if preferred. Furthermore, the discarded mass of the 420 square feet of the original supporting surface may be added to the weight of the motor and propellers in the design of a reduced aeroplane, since in this discussion the total mass is assumed constant at 1,000 pounds.

In the case of a bird's flight, its wing surface is "reefed" as its velocity is increased, which instinctive action serves to reduce its head resistance and skin-frictional area, and the consequent power required for a particular speed.

Determination of k for Arched Surfaces.—Since arched surfaces are now commonly used in aeroplane construction, and as the first equation applies to plane surfaces only, it is important to determine experimentally the value of the coefficient of figure k, for each type of arched surface employed, especially as k is shown in some cases to vary with the angle of flight a; *i. e.*, the inclination of the chord of the surface to the line of translation.

Assuming a constant, however, we may compare the lift of any particular arched surface with a plane surface of the same projected plan and angle of flight.

To illustrate, in the case of the Wright aeroplane, let us assume

$P = 1{,}000$ lb. $=$ total weight $= W$,
$A = 500$ sq. ft.,
$V = 40$ miles per hour $= 60$ ft. per second,
$a = 7$ deg. approximately.

Whence

$$k\sigma = P/2AV^2 \sin a = 1{,}000/(2 \times 500 \times 60^2 \times \tfrac{1}{8})$$
$$= 0.0022 \ (V = \text{ft. sec.})$$
$$= 0.005 \ \ (V = \text{mi. hr.}).$$

Comparing this value of $k\sigma$ with Langley's value 0.004 for a plane surface V being in miles per hour, we see that the lift for the arched surface is 25 per cent. greater than for a plane surface of the same projected plan. That is to say, this arched surface is dynamically equivalent to a plane surface of 25 per cent. greater area than the projected plan. Such a plane surface may be defined as the "equivalent plane."

Resistance and Propulsion.—The resistance of the air to the motion of an aeroplane is composed of two parts: (a) the resistance due to the framing and load, (b) the necessary resistance of the sustaining surfaces, that is, the drift, or horizontal component of pressure; and the unavoidable skin-friction. Disregarding the frame, and considering the aeroplane as a simple plane surface, we may express the resistance by the equation

$$R = W \tan a + 2fA,$$

in which R is the total resistance, W the gross weight sustained, a the angle of flight, f the friction per square unit of area of the plane, A the area of the plane. The first term of the second member gives the drift, the second term the skin-friction. The power required to propel the aeroplane is

$$H = RV,$$

in which H is the power, V the velocity.

Now W varies as the second power of the velocity, as shown by the first equation, and f varies as the power 1.85, as will be shown later. Hence we conclude that the total resistance R of the air to the aeroplane varies approximately as the square of its speed, and the propulsive power practically as the cube of speed.

Most Advantageous Speed and Angle of Flight.—Again, regarding W and A as constant, we may, by the first equation, compute a for various values of V, and find f for those velocities from the skin-friction table to be given presently. Thus a, R and H may be found for various velocities of flight, and their magnitudes compared.

The question of stability is a serious one in aviation, especially as increased wind velocities are encountered. In machines of the aeroplane type there must be some means provided to secure fore and aft stability and also lateral stability.

A large number of plans have been proposed for the accomplishment of these ends, some based upon the skill of the aviator, others operated automatically, and still others employing a combination of both. At the present time no aeroplane has yet been publicly exhibited which is provided with automatic control. There is little difference of opinion as to the desirability of some form of automatic control.

The Wright aeroplane does not attempt to accomplish this, but depends entirely upon the skill of the aviator to secure both lateral and longitudinal equilibrium, but it is understood that a device for this purpose is one of the next to be brought forward by them. Much of the success of the Wright brothers has been due to their logical procedure in the development of the aeroplane, taking the essentials, step by step, rather than attempting everything at once, as is so often the practise with inexperienced inventors.

The aviator's task is much more difficult than that of the chauffeur. With the chauffeur, while it is true that it requires his constant attention to guide his machine, yet he is traveling on a roadway where he can have due warning, through sight, of the turns and irregularities of the course.

The fundamental difference between operating the aeroplane and the automobile is that the former is traveling along an aerial highway which has manifold humps and ridges, eddies and gusts, and since the air is invisible he can not see these irregularities and inequalities of his path, and consequently can not provide for them until he has actually encountered them. He must feel the road since he can not see it.

Some form of automatic control whereby the machine itself promptly corrects for the inequalities of its path is evidently very desirable. As stated above, a large number of plans for doing this have been proposed, many of them based on gyrostatic action, movable side planes, revolving surfaces, warped surfaces, etc. A solution of this problem may be considered as one of the next important steps forward in the development of the aeroplane.

III. HYDROMECHANIC RELATIONS

At the present moment so many minds are engaged upon the general problem of aerial navigation that any method by which a broad forecast of the subject can be made is particularly desirable. Each branch of the subject has its advocates, each believing implicitly in the superiority of his method. On the one hand, the adherents of the dirigible balloon have little confidence in the future of the aeroplane, while another class have no energy to devote to the dirigible balloon, and still others prefer to work on the pure helicopter principle. As a matter of fact, each of these types is probably of permanent importance, and each particularly adapted to certain needs.

Fortunately for the development of each type, the experiments made with one class are of value to the other classes, and these in turn bear close analogy to the types of boats used in marine navigation. The dynamical properties of water and air are very much alike, and the equations of motion are similar for the two fluids, so that the data obtained from experiments in water, which are very extensive, may, with slight modification, be applied to computations for aerial navigation.

Helmholtz's Theorem.—Von Helmholtz, the master physicist of Germany, who illuminated everything he touched, has fortunately considered this subject, in a paper written in 1873. The title of his paper is "On a Theorem Relative to Movements that are Geometrically Similar in Fluid Bodies, together with an Application to the Problem of Steering Balloons."

In this paper Helmholtz affirms that, although the differential equations of hydromechanics may be an exact expression of the laws controlling the motions of fluids, still it is only for relatively few and simple experimental cases that we can obtain integrals appropriate to the given conditions, particularly if the cases involve viscosity and surfaces of discontinuity.

Hence, in dealing practically with the motion of fluids, we must depend upon experiment almost entirely, often being able to predict very little from theory, and that usually with uncertainty. Without integrating, however, he applies the hydrodynamic equations to transfer the observations made on any one fluid with given models and speeds, over to a geometrically similar mass of another fluid involving other speeds, and models of different magnitudes. By this means he is able to compute the size, velocity, resistance, power, etc., of aerial craft from given, or observed, values for marine craft.

He also deduces laws that must inevitably place a limit upon the possible size and velocity of aerial craft without, however, indicating what that limit may be with artificial power. Applying this mode of reasoning to large birds, he concludes by saying that, "It therefore appears probable that in the model of the great vulture, nature has already reached the limit that can be attained with the muscles as working organs, and under the most favorable conditions of subsistence, for the magnitude of a creature that shall raise itself by its wings and remain a long time in the air."

In comparing the behavior of models in water and air, he takes account of the density and viscosity of the media, as these were well known at the date of his writing, 1873; but he could not take account of the sliding, or skin-friction, because in his day neither the magnitude of such friction for air, nor the law of its variation with velocity had been determined.

Even as late as Langley's experiments, skin-friction in air was regarded as a negligible quantity, but, due to the work of Dr. Zahm, who was the first to make any really extensive and reliable experiments on skin-friction in air, we now can estimate the magnitude of this quantity. As a result of his research he has given in his paper on atmospheric friction the following equation:

$$f = 0.00000778\, l^{-0.07} v^{1.85} \ldots (v = \text{ft. sec.}),$$
$$f = 0.0000158\, l^{-0.07} v^{1.85} \ldots (v = \text{mi. hr.}),$$

in which f is the average skin-friction per square foot, and l the length of surface.

Relative Dynamic and Buoyant Support.—Peter Cooper-Hewitt has given careful study to the relative behavior of ships in air and in water. He has made a special study of hydroplanes, and has prepared graphic representations of his results which furnish a valuable forecast of the problem of flight.

Without knowing of Helmholtz's the-

orem, Cooper-Hewitt has independently computed curves for ships and hydroplanes from actual data in water, and has employed these curves to solve analogous problems in air, using the relative densities of the two media, approximately 800 to 1, in order to determine the relative values of support by dynamic reaction and by displacement for various weights and speeds.

An analysis of these curves leads to conclusions of importance, some of which are as follows:

The power consumed in propelling a displacement vessel at any constant speed, supported by air or water, is considered as being two thirds consumed by skin-resistance, or surface resistance, and one third consumed by head resistance. Such a vessel will be about ten diameters in length, or should be of such shape that the sum of the power consumed in surface friction and in head resistance will be a minimum (torpedo shape).

The power required to overcome friction due to forward movement will be about one eighth as much for a vessel in air as for a vessel of the same weight in water.

Leaving other things out of consideration, higher speeds can be obtained in craft of small tonnage by the dynamic reaction type than by the displacement type, for large tonnages the advantages of the displacement of type are manifest.

A dirigible balloon carrying the same weight, other things being equal, may be made to travel about twice as fast as a boat for the same power; or be made to travel at the same speed with the expenditure of about one eighth of the power.

As there are practically always currents in the air reaching, at times, a velocity of many miles per hour, a dirigible balloon should be constructed with sufficient power to be able to travel at a speed of about 50 miles per hour, in order that it may be available under practical conditions of weather. In other words, it should have substantially as much power as would drive a boat, carrying the same weight, 25 miles an hour, or should have the same ratio of power to size as the *Lusitania*.

Motors.—It is the general opinion that any one of several types of internal combustion motors at present available is suitable for use with dirigible balloons. With this type, lightness need not be obtained at the sacrifice of efficiency. In the aeroplane, however, lightness per output is a prime consideration, and certainty and reliability of action is demanded, since if by chance the motor stops, the machine must immediately glide to the earth. A technical discussion of motors would of itself require an extended paper, and may well form the subject of a special communication.

Propellers.—The fundamental principles of propellers are the same for air as for water. In both elements, the thrust is directly proportional to the mass of fluid set in motion per second. A great variety of types of propellers have been devised, but, thus far only the screw-propeller has proved to be of practical value in air. The theory of the screw-propeller in air is substantially the same as for the deeply submerged screw-propeller in water, and therefore does not seem to call for treatment here. There is much need at present for accurate aerodynamic data on the behavior of screw-propellers in air, and it is hoped that engineers will soon secure such data, and present them in practical form for the use of those interested in airship design.

Limitations.—Euclid's familiar "square-cube" theorem connecting the volumes and surfaces of similar figures, as is well known, operates in favor of increased size of dirigibles, and limits the possible size of heavier-than-air machines in single units and with concentrated load.

It appears, however, that both funda-

mental forms of aerial craft will likely be developed, and that the lighter-than-air type will be the burden-bearing machine of the future, whereas the heavier-than-air type will be limited to comparatively low tonnage, operating at relatively high velocity. The helicopter type of machine may be considered as the limit of the aeroplane, when by constantly increasing the speed the area of the supporting surfaces is continuously reduced until it practically disappears. We may then picture a racing aeroplane propelled by great power, supported largely by the pressure against its body, and with its wings reduced to mere fins which serve to guide and steady its motion. In other words, starting with the aeroplane type, we have the dirigible balloon on the one hand as the tonnage increases, and the helicopter type on the other extreme as the speed increases. Apparently, therefore, no one of these forms will be exclusively used, but each will have its place for the particular work required.

GEORGE O. SQUIER

MOSQUITO EXTERMINATION WORK IN NEW JERSEY

PROFESSOR JOHN B. SMITH, in his report to the governor on the work carried on under the law of 1906, shows that up to the end of the summer of 1908 there had been drained 20,292 acres of salt marsh extending from the Hackensack River to the mouth of Toms River on Barnegat Bay. To accomplish this, required 2,723,974 feet of ditching, put in at an actual cost of $44,058, some $12,000 being expended for administration, surveys and other work necessary to control the actual carrying out of the contracts.

During the same period of two years municipalities throughout the state have joined in the mosquito crusade, and have expended considerable sums of money for local work in eliminating breeding areas. The work is all in the direction of permanent improvement and of destroying the breeding localities. Oiling and temporary work is done only when it is necessary to destroy a brood of wigglers that might otherwise hatch before permanent work can be done.

The results have been very gratifying and the migrating marsh mosquitoes were almost entirely absent during most of the summer from the larger cities where drainage work had been done in 1907 or earlier. It developed in the course of the work that the eggs of these salt marsh species retain their vitality for a very long period and that for at least three years after a marsh is drained, there may be ever lessening broods of larvæ found whenever it becomes water-covered by freshet tides or heavy rains. This was interestingly shown by examinations of marsh mud, from areas drained for different periods, and counting the eggs and egg shells on the samples. It is, therefore, a rather slow process to completely clean up such areas, because a few specimens developing under favorable circumstances will provide a small stock of eggs that require three years or more to work out altogether. In the areas drained in 1904, however, practically no eggs were found except in the deepest depressions, and even in these they were very few in number and much scattered.

The season of 1908 was remarkable for the excessive rainfall in early spring, which provided breeding areas for the early brood, far beyond usual conditions, and these afterward concentrated in cisterns, water-barrels, sewer catch-basins and similar localities so that cities were much troubled by them in the entire region where these excessive spring rains prevailed.

If the legislature now in session provides sufficient means, it is expected that the drainage work can be carried to Great Bay during the season of 1909, and in the cities the local committees are already providing against a duplication of last season's experience with the house mosquito.

THE AMERICAN MUSEUM OF NATURAL HISTORY

THE annual meeting of the trustees of the American Museum of Natural History was held on Monday, February 8. The following officers were elected: Henry Fairfield Osborn,

president; J. Pierpont Morgan, first vice-president; Cleveland H. Dodge, second vice-president. The following is an abstract of the president's annual report:

In point of growth the past year has been the most notable in the history of the institution. Partly aided by the Jesup bequest, the total expenditures were $275,419, or $25,000 more than the previous year. Of this the city contributed $159,930.62 and the museum $115,488.38. In the past eight years the museum has expended directly $932,008 on its explorations and collections. The estimated total value of the collections secured during this period by exploration, by purchase, and by gift to the museum is over $2,000,000. For every dollar which has been expended by the city more than a dollar has been added to the enlargement of the collections.

The present endowment fund, including the bequest of the late President Jesup, is $2,048,156.61. To keep pace with the very rapid growth of the city and the demands it is making for public scientific education, an endowment fund of $5,000,000 is needed. In every part of the world the advance of agriculture and commerce and the spread of fire arms is rendering more scarce the objects of natural history of all kinds, including the works of the primitive races of men. It is deemed vitally important to push the explorations of the museum in all parts of the world while it is still possible to secure these fast vanishing works of nature and of primitive man. During the year 1908 and at the present time the museum's explorations extend to the Mackenzie River and the shores of the Beaufort Sea, to Alaska, Vancouver, Alberta and Saskatchewan, the west coast of Hudson Bay and western Labrador; in the United States parties have been spread in Wyoming, Montana, Idaho, North Dakota, Nebraska, Colorado and Florida, also in Central America, and in the south to Nicaragua, the West Indies and Bahama Islands; in Asia special agents are working in Kashmir, China and Corea; among the islands of the Pacific the museum is working in the Philippines, the Solomon Islands, in Tahiti, New Zealand, the South Shetland Islands and in Kerguelan Island.

Popular education has been given a stronger impulse than ever before. The museum was open free to the public every day of the year and on 179 evenings. The gross attendance last year was 1,043,582, in large part due to the exceptional interest in the International Tuberculosis Exhibition. The attendance at public afternoon and evening lectures reached a total of 82,718. The number of children visiting the museum in lecture classes was 10,425. The number of children who were especially guided through the Tuberculosis Exhibition and who listened to lectures on simple means of prevention of this disease was 41,627. These children came from all the high schools of Greater New York and from many distant towns and cities. In the schools of the city 575,801 children were reached by the system of circulating museums.

During the coming year the principal new exhibitions which will be developed are especially the Children's Museum, the Museum for the Blind, the Philippine Exhibition and the Congo Exhibition presented by King Leopold of Belgium. This last is the most complete collection outside of that which is to be seen in the Congo Museum near Brussels. Growing out of the Tuberculosis Exhibition immediate steps will be taken to make a special exhibition of the life and habits of the smaller organisms in relation to health and disease.

During the past year the scientific staff of the museum has been strengthened by the addition of Professor Bashford Dean, a traveler and ichthyologist of international reputation, who has been placed in charge of the fishes and reptiles. Professor Henry E. Crampton, also of Columbia University, has been appointed head curator of the department of invertebrate zoology to succeed Professor William Morton Wheeler, who has resigned to accept a professorship in Harvard University. Dr. Frank E. Lutz has been called from the Carnegie Institution of Experimental Evolution to take special charge of the exhibition of microorganisms in relation to public health. Dr. Alexander Petrunkevitch has been appointed honorary curator of arachnida, and Aarson L. Treadwell, of Vassar College, has been appointed honorary curator of annulates.

THE EIGHTH INTERNATIONAL ZOOLOGICAL CONGRESS

A LETTER recently received from Professor von Graff contains some information concerning the eighth International Zoological Congress, which will be held in Graz, Austria, in August, 1910, under his presidency. The exact dates are not yet determined, but the meetings will follow those of the Anatomical Congress to be held the same month in Brussels.

Graz is a city of about 130,000 inhabitants, beautifully situated at an elevation of 1,500 feet in the foot-hills of the Styrian Alps, and will be best approached by those coming from the west by the picturesque mountain road from Innsbruck. It has narrow, crooked streets in the older parts of the city and fine, new University buildings for the third educational institution of the empire. The city is overlooked by a fine park and it is proposed to have the evening meals served in one of the beautiful resorts in the neighborhood.

The present plans are to have the sessions occupy the week, from Monday to Friday, the general sessions coming in the morning, those of the sections in the afternoon. The number and character of the sections can not be stated at present, as they depend on the number of papers presented. On Saturday the plan is to make an excursion to Leoben, a beautifully situated village in the Styrian Erzberg, spending the night there.

On Sunday the train is taken over the new alpine railroad to Trieste. Monday forenoon is given to a visit to the Zoological Station at Trieste, founded by the late Professor Claus and famous for the character and amount of its work. Then a visit is made to the picturesque villa of Miramar, associated with the name of the unfortunate Maximilian, of Mexico. Rovigno with its zoological station is reached in the afternoon, and in the evening of Monday the steamer is taken for the four days trip down the beautiful and comparatively little known Dalmatian coast, with its mountainous background, its picturesque costumes and its magnificent remains of the later Roman empire. Stops will probably be made at Sebenico, Spalato, Ragusa and Cattaro, and from the latter place a ride of only a few hours takes one over the border and into the strange city of Cetinge, in Herzegovina. Friday brings the party back to Trieste, but arrangements may possibly be made, allowing those who wish, to stop over longer in Dalmatia. Those who return with the party will reach Vienna on Saturday, and the Congress will finally disband on Sunday.

Those who are interested should write to Professor L. von Graff, Graz, Stiermark, Austria, asking that the circulars, when issued, be sent them. Already several Americans have signified their intention to attend.

PROPOSED LINCOLN SCHOOLS OF SCIENCE

THE Minnesota Academy of Science has passed the following resolution:

WHEREAS: This meeting of the Minnesota Academy of Science takes place near the date of the one hundredth anniversary of the birth of Abraham Lincoln, and

WHEREAS: It is suitable and incumbent on the American people, in gratitude for the great service and sacrifice rendered by him to the fundamental elements of American civilization, to perpetuate his name and to honor it by inscribing it in conspicuous places where the youth may frequently be reminded of the excellence of his character, and

WHEREAS: The American Congress has by a commission appointed for this purpose, after long and extended consideration, recommended the construction of a great thoroughfare from Washington City to the battlefield of Gettysburg, and

WHEREAS: Still there seems to be room and opportunity to commemorate the name of Lincoln in a line of science in which he was a prominent actor, and

WHEREAS: It was by his signing and approving of the act of Congress of 1861 establishing the state schools known as Colleges of Agriculture and Mechanic Arts, to the maintenance of which this nation is committed, and which have since been called "National Schools of Science," of the United States, that the science of agriculture and mechanics have been benefited and firmly established in the educational curricula of the country, therefore,

Resolved, That it is the opinion of the members of the Minnesota Academy of Science that the name of Lincoln ought to be applied by Congress to these schools, and that all the literature and all the researches from such schools that may hereafter be published ought to be labeled and

everywhere known as products of the "Lincoln Schools of Science."

It is the opinion of this academy that by so designating these schools, while an immaterial and uncostly honor would be conferred on the greatest American citizen, such honor would be likely to be more influential and more durable in the perpetuation of his memory than the expenditure of large sums of money in material monuments of any kind.

FIRST AWARD OF THE LANGLEY MEDAL

THE first award of the gold medal recently established by the Smithsonian Institution in memory of the late Secretary Samuel Pierpont Langley and his contributions to the science of aerodromics is made to Wilbur and Orville Wright. The board of regents of the institution has adopted the following resolution:

Resolved, That the Langley medal be awarded to Wilbur and Orville Wright for advancing the science of aerodromics in its application to aviation, by their successful investigations and demonstrations of the practicability of mechanical flight by man."

Following the establishment of the Langley medal, Secretary Walcott appointed the following-named gentlemen of known competence in the subject of aerodromics as a committee on award, announcement of which is hereby made: Mr. Octave Chanute, of Chicago, Chairman; Dr. Alexander Graham Bell; Major George O. Squier, U. S. A.; Mr. John A. Brashear, of Allegheny, Pa., and Mr. James Means, formerly editor of *The Aeronautical Annual*, Boston. The Langley Medal was founded "to be awarded for specially meritorious investigations in connection with the science of aerodromics and its application to aviation." The original design to be used for this medal was made by Mon. J. C. Chaplain, of Paris, a member of the French Academy. The medal bears on its obverse a female figure, seated on the globe, carrying a torch in her left hand and in her right a scroll emblematic of knowledge and the words "Per Orbem." The reverse is adapted from the seal of the institution as designed by Augustus St. Gaudens, the special inscription being inserted in the center instead of the map of the world. It is about three inches in diameter.

SCIENTIFIC NOTES AND NEWS

THE Astronomical Society of the Pacific has awarded its Bruce gold medal for the year 1909 to Dr. G. W. Hill for distinguished services to astronomy.

THE eminent mathematician, M. Henri Poincaré, was officially received on January 28 into the French Academy, taking the seat vacant by the death of the poet Sully Prudhomme. M. Fréderic Masson, the historian of Napoleon, made the address of welcome.

LORD RAYLEIGH, who left England with Lady Rayleigh for a six months' tour around the world, has been seriously ill in South Africa, but is now better. He has given up his plan of going to Australia, and will probably finish the winter in Egypt.

THE celebration of Haeckel's seventy-fifth birthday was held in Jena on February 16. As a gift from the American Museum of Natural History to the Phyletic Museum Professor Osborn has sent a series of the large reproductions of Charles R. Knight's restorations of the extinct vertebrates of North America.

DR. S. WEIR MITCHELL celebrated his eightieth birthday on February 15.

PROFESSOR RAMON Y CAJAL, the anatomist, has been created a senator of Spain.

M. LOUIS MANGIN has been elected a member of the Paris Academy of Sciences, in the section of botany, to succeed M. Van Tieghem, who has been elected permanent secretary.

PROFESSOR WILLIAM Z. RIPLEY, of Harvard University, has been elected an honorary fellow of the Royal Anthropological Institute of Great Britain and Ireland, in recognition of his researches in the field of European and American demography.

PORTRAITS of Professor George J. Brush and of Professor William H. Brewer have been hung in the recently fitted-up faculty room of the Sheffield Scientific School, Yale University. Professor Brush and Professor

Brewer both graduated from the school in the class of 1852.

A NUMBER of physicians who have been operated on by Dr. John B. Deaver, of Philadelphia, gave a dinner in his honor at the University Club on February 14. More than 150 physicians are included in this category. A loving cup was presented to Dr. Deaver.

THE election of Professor S. Kitasato, director of the Infectious Diseases Institute, at Tokyo, to the honorary fellowship of the Royal Society has been made the occasion of a dinner given in his honor by a number of his pupils and friends. Congratulatory addresses were delivered by Professor Kitajima and Dr. T. Takaki, director of the Formosan Medical Institute.

THE title of honorary keeper of the Ashmolean Museum, Oxford, has been conferred upon Dr. Arthur Evans "in consideration of his eminent services to the university as keeper of the Ashmolean Museum, extending over twenty-five years." The thanks of the university were also given to Dr. Evans for his recent gift to the museum.

DR. KARL J. OECHSLIN, of Leipzig, for the past year associated with Professor Michael, of Tufts College, began his new work in the Division of Chemistry, Bureau of Science, Manila, P. I., on January 1.

MR. CHARLES S. BANKS has resumed his duties as entomologist in the Bureau of Science, Manila, P. I., after five months spent in America and Europe in the identification of Philippine material. He worked largely on Philippine Culicidæ, Hemiptera and Orthoptera in the British Museum, and with Dr. Bouvier, in Paris, on Mallophaga, and Dr. Leonardi, in Portici, on Coccidæ and Termitidæ.

PROFESSOR J. B. WOODWORTH, of the geological department, of Harvard University, has returned to Cambridge from his extended trip in South America. He left Cambridge last June and has spent the intervening time in scientific investigation in Brazil and on the western coast of the continent. The trip was made possible by the Shaler Memorial Fund and is the first of a series of similar expeditions to be made under the same provision.

MR. GEORGE H. SHULL, of the Cold Spring Harbor Station for Experimental Evolution, has returned from a three-months' trip to Europe undertaken for the purpose of studying scientific and economic plant breeding. He has now gone to California to resume his work on Mr. Burbank's methods and results.

MR. and MRS. C. WILLIAM BEEBE sailed for Georgetown, British Guiana, on February 15, on the Royal Dutch mail steamer *Coppename*. A month or more will be spent in the interior for the purpose of studying the more generalized types of birds inhabiting this country. Mr. Lee S. Crandall will accompany Mr. Beebe as assistant, and the attempt will be made to bring back alive for the New York Zoological Park some of the more interesting birds and other animals.

MR. ELLSWORTH HUNTINGTON, of the geological department of Yale University, sailed on February 10 on the *Majestic* for Southampton. He is going to Jerusalem by the way of Constantinople, taking with him Mr. C. F. Graham, a Yale senior, as assistant. They will study the former shorelines around the Dead Sea. Their plan is to use a folding boat and visit various points on its shores. The special problem to be solved by this expedition is as to whether any of the shorelines record expansions of this sea within historic times. After leaving the Dead Sea some two months will be spent in the study of the geography of Palestine and the Syrian Desert, with special reference to changes of climate and the effect which the geographic environment has had upon the people and their history. The third objective point will be in the lake region of Asia Minor, where some three months will be spent in the study of the same problems of shorelines, climate and man. This expedition is made under the auspices of Yale University, which defrays a portion of the expenses.

PROFESSOR JULIUS STIEGLITZ, of the University of Chicago, will deliver shortly at the University of California a series of eight or ten lectures, on some aspect of chemistry. This will be the first series of lectures on the

Hitchcock foundation, provided for by the bequest of C. M. Hitchcock in 1885.

Sir Jagadis Chunder Bose, M.A., Sc.D., professor of physics and biology at the Presidency College, Calcutta, India, recently lectured at the University of Illinois on the subjects of the polarization of electric waves, the mechanical responses of plants, and the electric responses of plants.

Professor William T. Sedgwick, of the Massachusetts Institute of Technology, will give a series of lectures at the University of Illinois, from April 19 to 24, under the general head of "Science in the Service of Public Health."

A series of public lectures is to be given at Columbia University on March 8, 15 and 22 at 5:10 P.M. by Alexander S. Chessin, professor of mathematics in Washington University, on the gyrostat. The first lecture will be devoted to a brief history of the gyrostat showing its development from a mere toy into a scientific instrument and a mechanism of great value. The second lecture will be on the influence of the world's rotation on the motion of gyrostats, Foucault's top and the applications of the gyrostat to astronomy and to surveying. The third lecture will be upon the gyrostat in modern industries, and will be devoted to the devices for torpedoes, the steadying of ships at sea, the Schlick marine gyrostat, the monorail car, and the experiments of the German navy, all fully illustrated.

At the last meeting of the Middletown Scientific Association, held on February 9, Professor William North Rice spoke on the life of Darwin.

In accordance with the plan which we have already announced, a heroic bronze bust of Darwin, by the sculptor Mr. William Couper, was presented by the New York Academy of Sciences to the American Museum of Natural History on February 12. The address of presentation was made by Mr. C. F. Cox, president of the academy, and the bust was accepted on behalf of the trustees of the museum by Dr. H. F. Osborn, president. Addresses were then made on "Darwin and Geology," by Professor J. J. Stevenson; "Darwin and Botany," by Dr. N. L. Britton, and "Darwin and Zoology," by Dr. Hermon C. Bumpus. In connection with the celebration a special exhibition has been installed in the museum, consisting of Darwiniana and series of specimens and groups of specimens bearing upon the Darwinian theory of evolution through natural selection. The exhibition will continue for one month.

Professor August Weismann finds himself unable, in consequence of his advanced age, to accept the invitation of the University of Cambridge to attend the Darwin Centenary celebrations and to deliver an address.

Dr. George E. Hale, of the Solar Observatory on Mount Wilson, has been appointed a delegate to represent the National Academy of Sciences at the Darwin Celebration at Cambridge.

The Cambridge University Press will present to each invited guest at the approaching Darwin centenary celebration a copy of the first draft of "The Origin of Species," which is being prepared for press and edited by Mr. Francis Darwin. This is the draft of which Mr. Darwin speaks in his autobiography: "In June, 1843, I first allowed myself the satisfaction of writing a very brief abstract of my theory in pencil in 35 pages."

Mr. Walter Morrison Allen, known as a designer of telescopes, died in Cleveland on February 8, at the age of forty-two years.

Mr. Wilfred Huddleston, F.R.S., the eminent British geologist, died at his home at Dorset on January 29, in his eighty-first year. The death is also announced of M. A. Legoux, who for many years occupied the chair of mechanics at Toulouse.

The general secretaries of the British Association have issued a preliminary circular in regard to the meeting at Winnipeg beginning on August 25. No reduction in rates is made by the steamship companies, but special accommodation will be reserved on the Canadian Pacific steamship *Empress of Ireland*, sailing from Liverpool to Montreal on August 13. It is expected that a single fare will be granted on the Canadian railways for the return trip from Montreal to Winnipeg and from Winni-

peg to Victoria. The official party will leave Winnipeg at midnight on September 2 for the trip to the Pacific coast, and will return to Winnipeg on September 13.

THE fiftieth anniversary of the founding of the Paris Society of Anthropology will be celebrated July 7–9, 1909. Anthropological societies and institutions are invited to send delegates. The program includes a discourse by the minister of public instruction and fine arts, an address by the president of the society, a report by the general secretary on the scientific activities of the society since its foundation, and messages from delegates who are to be the guests of the society at a luncheon and a dinner.

THE Royal Institution, London, has received from a lady who wishes to remain anonymous a gift of £10,000.

THE trustees of the Elizabeth Thompson Science Fund are prepared to receive applications for appropriations in aid of scientific work. All applications should reach, before March 15, 1909, the secretary of the board, Dr. C. S. Minot, Harvard Medical School, Boston, Mass.

ACCORDING to the Berlin correspondent of the London *Times* the latest available details of the new German airship Zeppelin II., which will be launched in March, state that the total length of the vessel is 446 feet, the diameter 42 feet 8 inches, and the cubic contents about 530,000 feet of hydrogen. There are 17 ballonets, of which 16 are of india-rubber-treated cotton, and the seventeenth is of goldbeaters' skin, and is supplied by a well-known firm of English aeronauts. The two Daimler motors weigh 798.8 pounds, and produce together about 200 horse power. The two aluminium cars form cabins for the captain, hammocks being provided for the men. The cars are furnished underneath with soft fenders in order to lessen the shock of landing on the hard ground. An immense shed is being built to accommodate Zeppelin II. as soon as it is launched.

THE production of petroleum in the United States in 1908, according to a preliminary estimate made by David T. Day, of the United States Geological Survey, amounted to between 175 and 180 million barrels, an increase between 5 and 9 per cent. as compared with the production of 166 million barrels in 1907. The total value of the product showed an even greater proportionate gain, for the price of oil increased in California and remained steady in other fields except the Gulf. The increases are attributed to steady growth in Illinois and California, though neither field showed phenomenal development.

MR. D. O. MILLS has given to the department of mammalogy of the American Museum of Natural History eight specimens of the fur seal, to be utilized in the preparation of a group illustrating a seal rookery. The specimens were collected at the Pribilof Islands, Alaska, expressly for the museum, by order of Mr. Mills, who had special permission from the Department of Commerce and Labor for their capture. The series consists of male seals two, three, five and seven years old, female seals three and four years old and two pups six weeks old.

BARON DE LENVAL, on the occasion of the Third International Otological Congress, founded a prize of 3,000 francs to be awarded to such person as should invent and produce a small portable instrument materially assisting the hearing of the deaf. As no such instrument has yet been forthcoming to the satisfaction of the international jury appointed to adjudicate upon the matter, the accumulated interest of four years, amounting to about 400 francs, will be awarded as a prize for the best work that has been published during the last four years in the departments of the anatomy, physiology, or pathology of the organ of hearing. Competing works should be sent to the president of the jury, Professor Dr. A. Politzer, I. Gonzagasse 19, Vienna, before the end of February.

UNIVERSITY AND EDUCATIONAL NEWS

THE two hundred thousand dollars required to secure the gift of $600,000 from Mr. John D. Rockefeller for the Harper memorial library at the University of Chicago has now

been secured. A building will be erected, but part of the money has been reserved for an endowment.

President Charles F. Thwing, of Western Reserve University, announces the completion of a $500,000 fund for additional endowment of Adelbert College and the college for women. Of this amount $125,000 was offered by the General Education Board, on the condition that $375,000 be raised by the university.

Hamline University, St. Paul, Minn., has been offered $75,000 by the General Education Board of New York on the condition that it will raise three times the amount, making a total of $300,000, a large portion of which is to be added to the permanent endowment.

The department of engineering of the University of Michigan has received a gift of the library of the late George Y. Wisner and a rotary engine of the value of $7,000 from Mr. J. D. R. Lampson.

Americans who have received honorary degrees at Oxford have made through President Butler, of Columbia University, a gift of $1,200 for the endowment fund.

Lord Winterstoke has offered to give an additional £15,000 towards the proposed Bristol University. This will make a total contribution from him of £35,000.

We are informed that the statement quoted here from the daily papers to the effect that the office of chancellor would be established at the University of Michigan for President Angell to hold after his resignation is incorrect.

The daily papers state that the presidency of Dartmouth College has been offered to Mr. S. W. McCall, member of congress from Massachusetts since 1893 and a graduate of Dartmouth College in the class of 1874. Statements in regard to college presidencies printed in the daily papers seem, however, to have a large probable error.

Dr. Fletcher B. Dresslar, associate professor of education at the University of California, has become head of the department of philosophy and education in the University of Alabama.

DISCUSSION AND CORRESPONDENCE

HARVARD UNIVERSITY AND THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

To the Editor of Science: I note in Science of January 29 a quotation from a Boston newspaper in regard to "Harvard University and the Massachusetts Institute of Technology"; and it seems desirable that certain erroneous impressions conveyed therein should be corrected.

The important misconception in the article in question is implied in the statement: "It seems probable that the taking from the institute by Harvard of two of its leading professors will bring up again the question of a consolidation or of an alliance between these two educational institutions." This is not only not probable; it is entirely unthinkable, to those acquainted with the true situation. The opposition of the faculty and alumni of the institute to this plan is founded on good and substantial reasons, which are too generally understood and respected to be questioned again.

The Technology faculty and alumni did not oppose the proposed alliance from mere pride in the achievements of the institute, or from any narrow fear that it would lose its individual reputation. They simply recognized that Harvard and Technology represent different and incompatible educational ideals. Harvard's ideal is that of graduate scientific schools following a college course based on the elective system. This, so far as engineering goes, is an interesting and promising experiment and one to which Technology can cheerfully contribute two of her honored sons. Technology herself, however, stands for a different ideal, for a combination, from the beginning, of a broad scientific training with the elements of liberal culture, in a four years' course, laid along the lines of a carefully balanced group system of studies. This ideal has not been fully realized; few ideals ever are; yet in the flux of doubt and questioning which seems to have engulfed the world of higher education, the record of what the institute has actually accomplished stands out as one of the

clear and positive achievements of the last half century.

I almost apologize for calling attention to another sentence in the quotation: "The institute, on the other hand, is handicapped by an improper location and insufficient funds to compete successfully against Harvard."

The readers of SCIENCE ought to be assured that while Technology needs, and would gladly receive, gifts for its growing work, it has so far been able to make both ends meet without serious difficulty. The new president, Professor Maclaurin, experienced in education on three continents, comes to the institute with complete enthusiasm for its special ideals. A body of eight thousand alumni and past students stand ready for loyal service. The institute is now contemplating a move from its present location, which it will soon outgrow, to a new and ample one where a group of buildings worthy of its dignity will be erected. "The Old Technology, with its old traditions and its old ideals, new built on a new site," as acting President Noyes recently phrased it, will not "compete against Harvard"; but it will welcome the McKay school of applied science as a worthy ally in the great war against ignorance that we are all waging together.

C.-E. A. WINSLOW

THE RIGHT AND THE WRONG IN POPULAR SCIENCE BOOKS

To put in simple and elegant language descriptions and explanations of natural phenomena is to offer every one that knowledge and understanding that broadens our sympathies; that increases our interest in the world about us; that makes us more contented and more useful human beings. No nobler work than this can any man do—the work that Tyndall, that Sir Robert Ball, that Darwin and many another devoted follower of nature loved so much and did so well. The popular books that men like these produce can never be too numerous, nor can the publisher devote to them more of his beautifying art than they deserve.

Unfortunately, however, there is another class of books with natural phenomena for their titles; books, of which the one under review is typical, attractively written and prettily illustrated, but filled with false explanations—counterfeit mental coin palmed off on the innocent, to their inestimable harm. Such books do not spread knowledge, nor do they even leave the mental tablets of the uninformed receptively blank, but, on the contrary, scribble all over them an almost ineradicable jumble of errors, which must somehow be got rid of before the unfortunate victim is ready even to begin to learn the truth.

Surely the author of a book treating of a scientific subject must know that he knows what he is talking about, or know that he doesn't know. In the first case, let his explanations be simple, clear, complete. In the second let him have sufficient judgment to leave attempted explanations alone, for they are sure to be wrong, and therefore harmful.

But the fault is not alone with the author. The publisher is expected, and properly so, to guarantee, to the best of his knowledge, the accuracy of the books he offers for sale. And this, it would seem, should impose upon him the duty of submitting all manuscripts of popular nature-books to competent specialists. In this way "Water Wonders Every Child Should Know,"[1] like many another of its kind, might easily have been made the excellent book that at first glance it appears to be, instead of the thing of blunders it actually is.

This little book is beautifully got up, attractively written and filled with many of Mr. Bentley's choicest snow and frost photographs, but as it now stands it can be recommended to those only who already have a knowledge, sufficient to protect them from its errors, of the subjects, dew, frost, snow, ice and rain, of which it treats; and to them simply for its beautiful pictures. But these latter are so numerous and so beautiful that it is to be hoped that there will soon be a new and properly revised edition, one that can be recommended for the accuracy of its explanations as well as for the beauty of its illustrations.

W. J. HUMPHREYS

[1] Jean M. Thompson, "Water Wonders Every Child Should Know," Doubleday, Page & Co., 1907.

QUOTATIONS

THE UNIVERSITY PRESIDENT AND THE UNIVERSITY PROFESSOR

In Professor A. Lawrence Lowell's first formal address as president-elect of Harvard University, printed in the *Harvard Bulletin*, he says:

It is commonly thought that President Eliot has ruled Harvard and the faculty with a heavy hand. It is not so. When I went to Cambridge one of my colleagues said to me: "If you fail to give satisfaction you will go; but so long as you give satisfaction you may teach as you please." That has been President Eliot's method of treating his subordinates, the members of the faculty.

Is it to be understood that as president of Harvard University Mr. Lowell proposes to retain his subordinates only so long as they give him satisfaction?

The president of another great university has recently expressed his opinion of the relation between the university president and the university professor. In his recently printed lectures before the University of Copenhagen, President Butler, of Columbia University, writes:

Almost without exception the men who to-day occupy the most conspicuous positions in the United States have worked their way up, by their own ability, from very humble beginnings. The heads of the great universities were every one of them not long ago humble and poorly compensated teachers.—An 'Umble Professor in *The Nation*.

MAMMALS IN THE CONGRESS

Mr. Macon—"Another question. I notice that it is proposed to preserve mammals. What kind of mammals are there up there? I notice here some mammals that you want to preserve there. What are mammals, and of what use will they be to the government?"

Mr. Gronna—"So far as I know, there are no mammals on the islands. The species of birds we have, I have mentioned. We have also the white pelican——"

Mr. Macon—"Are these mammal birds?"

Mr. Gronna—"We have on those particular islands birds that are found nowhere else in the United States, I will say to the gentleman from Arkansas. We have the white-winged scoter, that is not found anywhere else in the interior of this country."

Mr. Macon—"But I want to know about the mammals."

Mr. Gronna—"I am not discussing or referring to mammals."

Mr. Macon—"But I want to know about them."

Mr. Gronna—"I am talking about birds."

Mr. Macon—"I have understood they are something like rats, gophers, or something of that kind."

Mr. Humphreys—"Or 'possum."

Mr. Macon—"Oh, no——"

Mr. Gronna—"I will say in reply to the gentleman from Arkansas that if there are any mammals there of any value we will be very much pleased to preserve them."

Mr. Macon—"But what are they good for?"

Mr. Gronna—"I say we have none that I know of."

Mr. Macon—"What are they good for, or what would they be good for if they were there?"

Mr. Gronna—"I will say to the gentleman from Arkansas that my reply to the gentleman was this, that if there are any mammals of any value we would desire to preserve them."

Mr. Macon—"I am trying to get at what they are good for, but it seems that the gentleman can not inform me."

SCIENTIFIC BOOKS

Pulmonary Tuberculosis and Its Complications. By Sherman G. Bonney, M.D., Professor of Medicine, Denver and Gross College of Medicine, Denver. 8vo, pp. 778, with 189 original illustrations, including 20 in colors and 60 X-ray photographs. Philadelphia and London, W. B. Saunders Company. 1908. Cloth, \$7 net; half morocco, \$8.50 net.

Dr. Bonney has given us a most valuable book, and one replete with interest. It embodies "largely the results of personal experience." Dr. Bonney has for many years enjoyed a large practise, and has had unusual opportunities for clinical study, which have

been put to good use. His observations and conclusions have therefore great value.

While the book is, as he says, designed for the general practitioner, one of the best written and strongest portions is Part VI., section I., in which he deals with Prophylaxis. Under this general head we find discussed Notification and Registration, Education for the Consumptive and the Public, the giving of Material Aid, and Administrative Control. These chapters are well adapted for general reading, and we wish that the educated public, and especially those charged with the making and administration of our laws, could be forced to study them. A single quotation only can be given:

> Society, which sometimes encompasses the regular and legitimate practitioner of medicine with embarrassing restrictions, yet permits the unsuspecting invalid to become the non-defensive prey of ignorant and unscrupulous charlatans. While many forms of quackery have been overlooked, and the advertisement and sale of patent medicines containing alcohol and various narcotics have been permitted, the state, by virtue of its failure to enact repressive legislation or to enforce existing laws, has become indirectly responsible for the lack of public health.

At present interest is again turned to the relation between bovine and human tuberculosis. Dr. Bonney's conclusions are in the main sound and practical. While admitting the danger to man from cattle, he says: . . . "among individuals a greater virulence attaches to the bacillus of human origin than to the bovine." This statement is incorrect. If it means that the consumptive man is the chief source of danger to man, we will agree with it, but no one has ever shown that the human bacillus is more virulent for man than the bovine germ, and there is good reason to believe that the contrary is true.

The discussion of staining is meager, and no mention is made of the non-acid-fast forms of the tubercle bacillus, a most important matter pointed out by E. Klebs, Much, Michaelides, Herman and others. What he says against waiting to make a diagnosis until tubercle bacilli are found in the sputum is eminently sound. Much valuable time is lost, and many lives sacrificed by this wide-spread, but most pernicious, practise.

The methods given for isolation of cultures are incorrect.

The sections of the book which will probably most interest the practitioner are those on diagnosis, symptomatology, complications and treatment. These occupy the major portion of the book, and are illustrated by many excellent and well-chosen cuts.

The classification of cases is not in accordance with the modern trend, and no mention is made of the classification advised by the National Association.

The subject-matter in these sections is very full and contains a vast amount of practical knowledge.

Sixty X-ray photographs are given, most of them excellent. Dr. Bonney properly regards the X-ray as a valuable aid to diagnosis. He considers the "legitimate scope of the subcutaneous tuberculin test to be extremely limited," though he says it is "not only harmless, but has a high diagnostic value" when intelligently employed. While recognizing the care necessary in the use of tuberculin, we believe its use should be extended, and in view of what he says, it is illogical to limit its use as he does.

Dr. Bonney is an advocate of the most pronounced type of the climatic treatment of tuberculosis. For him the ideal climate is found in Colorado, especially in Denver and Colorado Springs. Even in those features which apparently detract from the perfect ensemble, he finds "concealed" desirable features. It would be hard to imagine a more marked contrast than his description of Colorado and the Adirondacks. The latter he says have a comparatively small number of sunny days, moderate humidity, and an abundance of clouds, fog, snow and rain, yet admits that they have a "well-deserved reputation as a place of sojourn for pulmonary invalids." From his description certainly no more unsuitable climate could be found, yet we know that the results obtained there are among the best in any part of the world.

His reiterated advice concerning "regard for infinite detail" in the treatment of tuber-

culosis is to be most highly commended, and we suspect that much of the good he attributes to climatic influences is due to this minute personal attention, which is the keynote of successful treatment in any climate. It would be fairer, and the arguments have more weight, if Dr. Bonney proved by statistical comparison the marked advantages of Colorado over what he considers less favorable regions.

In the treatment of hemorrhage on page 717, Dr. Bonney wisely, we think, advises against the use of all drugs calculated to reduce the volume of blood in the lungs, as worthless and harmful. On page 722, however, he speaks highly of placing ligatures around the extremities, which act by reducing the volume of blood, though the pathologic changes which prevent the contraction of the vessels at the site of bleeding must act with equal force in both cases.

The chapter on Theories of Immunity is the weakest part of the book, and should be omitted in the future, or re-written. The text is far from clear, and many inaccurate expressions are used, such as "toxic infection," "receptor cells," "protective poisons," "bacilli emulsion," etc. If his description of an antitoxin means anything it is that antitoxins consist of an excess of haptophores!

In describing Wright's technique we are told that the film is so spread as to insure even distribution of the cells. This is exactly what we try to avoid, Wright having devised a special method of spreading with the end of a slide for the purpose of pressing the leucocytes to the edges and end of the smear, to facilitate counting.

The *italic* is overworked throughout the book.

The names of Lassar, Delépine, Vallée, Gabbett, Descos and Larrier are misspelled.

It is more easy to pick flaws than to construct a book, but in a work of such general excellence, it is particularly disappointing to find such defects as have been pointed out.

The printing is good, and the illustrations throughout are first class, from the technical, as well as the educational standpoint.

In spite of the defects, and though we may not agree with Dr. Bonney in some of his views, we consider the book a valuable addition to our knowledge of the terrible disease of which he treats. Not only the general practitioner, for whom the book is written, but the specialist will find it well worth careful study.

MAZŸCK P. RAVENEL

The World's Gold. A Discussion of the Geological Occurrence of Gold, Its Geographical Distribution, Its Extraction and Methods of Milling, and the Economy of Gold. By L. DE LAUNAY, Professor in the École Supérieure des Mines. Cloth; 5½ x 8½ ins.; pp. 242. $1.75 net. New York, G. P. Putnam's Sons.

The preface of this work is an interesting thesis on the function of gold in the world's industrial development. According to the author, it is not only the basis of all wealth, but it is "the whole of wealth"; furthermore, it is a great civilizer and one of the most powerful agencies making for the development of the resources of the world.

The chapters on the geological occurrence and geographical distribution of gold are of necessity, in a work of this character, unsatisfactory and far from exhaustive. The same may be said, and with greater force, of the chapter on extraction and dressing of gold ores—practically no definite or clear ideas can be acquired by a perusal of these chapters. However, from the standpoint of the economist, scientific details are not necessary.

The main value of this work lies in the chapter on the Economy of Gold, and it may be said that in this respect it is a positive and exceedingly valuable addition to the literature on the relation of gold to money and commerce.

L. de Launay examines the problem of the future supply of gold from the scientific standpoint and correlates the influence of this supply with prices and the movement of capital from the financial standpoint. Thus he performs the rare service of welding together the technical and economical aspects of the subject.

Taken as a whole, the work is well and logically written and fairly accurate in facts and figures. It is a work which will be read with interest by both technical and non-technical readers, and especially by those interested in the financial aspect of money and metals.

Walter R. Crane

On the Witness Stand: Essays on Psychology and Crime. By Hugo Münsterberg, Professor of Psychology, Harvard University. Pp. 269. New York, The McClure Co. 1908.

Professor Münsterberg writes as the champion of a cause. A new science is taking shape. Fifty laboratories are its servants. It is applied psychology (p. 9). Education, medicine, art, economics and law are its natural fields; but the obdurate lawyer bars it out of the last.

The reader of these essays, who is familiar with the practise of courts, will question if the author gives them sufficient credit for the rules which they have themselves worked out to aid them in the search for truth. His criticisms are addressed to those in which the trial is by jury, and there is no examination of the accused by the presiding judge. The American juryman is commonly of more than average education and ability, else he would not be found upon the panel. Among twelve such men there will be those who have met, not only the ordinary, but some of the extraordinary experiences of life. They all know what strong emotion is. They are no strangers to the force of temptation, of suggestion, of the association of ideas. They are in one respect, and that an important one, more competent to weigh the value of testimony than a professor of psychology, because they are nearer to the ordinary witness in character and circumstance. They have learned from a lifetime of buying and selling, of giving and obeying orders, of hiring and discharging, of hearing news and telling news, how difficult it is for two men to see or understand a thing in exactly the same way, and how impossible it is for them to describe it exactly in the same way.

The lawyers and judges, too, have been schooled in certain rules of evidence. Professor Münsterberg is wrong when he says (p. 22) that they hope to get the exact truth, when they ask some cabman how much time passed between a cry and a shot. They know, and the jury know, that what seems to some a space of minutes, will seem to others, and perhaps with better reason, a space of seconds. Witnesses may differ on the size or length or form of a field, "and yet," says the author (p. 33), "there is no one to remind the court that the same distances must appear quite differently under a hundred different conditions." He would have the psychologist intervene, and explain all this to a dozen men whose every-day experience has taught it to them from boyhood.

So when he declares (p. 44) that "the confidence in the reliability of memory is so general that the suspicion of memory illusions evidently plays a small rôle in the mind of the juryman" and cross-examining lawyer, he discredits their intelligence on quite insufficient grounds.

Professor Münsterberg would have witnesses examined by a psychologist (pp. 46, 62) with regard to their powers of perception and memory, their faculty of attention, their lines of association, the strength of their volition, and their impressibility by suggestion. He does not tell us whether he would have this examination take place in or out of court. If in court, it is obvious that it would greatly multiply the questions for the jury to decide, and be mainly unintelligible to them except as supplying a basis for the examiner's ultimate conclusions: if out of court, it would involve wearisome statements, probably from more than one expert, of the experiments tried, and open the way to a still more wearisome cross-examination. In either case, the prospect of submitting to such an ordeal would make many men and more women unwilling to testify in court, and so tend to dissuade them from letting it be known that they are cognizant of material facts.

The author urges a resort to the association-test, or the automatograph, in the case of those charged with crime; saying that (pp. 82, 124, 132) a guilty man, of course, will not object,

since he can not refuse and yet affirm his innocence. This ignores the settled construction of the provision in all our constitutions that the accused can never be compelled to give evidence against himself.

The effect of suggestion on a witness is spoken of as something to be understood and explained only by a professed psychologist (p. 158). The rule of all Anglo-American courts which excludes questions naturally leading to a desired answer as to a material fact, shows how well jurists have appreciated this particular tendency of the human mind.

The position of the Lombroso school that a criminal, like a poet, *nascitur, non fit,* is pronounced untenable (p. 234). We are all potential criminals; not actually such, largely, because we are afraid of unpleasant consequences, and society has been so kind as to environ us with circumstances favorable to the development of this fear (pp. 238, 250, 266). The clearest sources of pure life are (p. 262) "the motives of private, personal interest between human being and human being."

Disrespect for law the author counts as an important cause of crime. In that view, it is questionable whether he was wise in giving so much space to the psychological aspects of two recent murder trials; that of Moyer (p. 92), in which he made a scientific examination of the main witness for the state and concluded that he was an honest one, though the jury did not believe him, and another in Chicago (p. 163), where a man was hanged upon his own confession, whom Professor Münsterberg, without having examined him, pronounced innocent.

Like all that comes from the author's prolific pen, this book is thoughtful and suggestive. It would be more valuable if, instead of dwelling solely on the aid which psychological experts could render to courts, he had also discussed the practical difficulties which lie in the way.

SIMEON E. BALDWIN

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for February contains the address of Charles F. Cox, president of the New York Academy of Sciences, on "Charles Darwin and the Mutation Theory." The author presents many facts to show that Darwin was well aware of the tendency of many species to sudden and marked variations, these variations being perpetuated, but that, nevertheless, he was convinced that this was exceptional and extraordinary. Such being the case, he would scarcely have subscribed to De Vries's *dictum* that species and varieties have originated by mutation and at present are not known to have originated in any other way. Robert F. Griggs presents the second, and concluding, part of his article on "Juvenile Kelps and the Recapitulation Theory," the decision being that except as some tendency has operated to change the heritage the history of the individual does recapitulate the history of the race.

The Zoological Society Bulletin for January opens with part two of a paper on the "New World Vultures," by C. William Beebe. This is largely devoted to the California condor, but also contains an account of an interesting experiment to test the sense of smell in the vultures; it seems to be almost lacking, and is best developed in the turkey buzzard. There is an account of how the hippopotamus was moved to the new elephant house and a note giving the weights of the elephants and rhinoceroses. Hunting song birds has not ceased entirely in the vicinity of the park and they are occasionally sought with shot-gun and traps.

The Museums Journal of Great Britain contains, besides its many interesting notes and reviews, "The History of the Ipswich Museum," by Frank Woolnough, and an article by L. Wray, on "The Preservation of Mammal Skins." This is of importance from the fact that the writer gained his experience in the Perak Museum, where he had to contend with the hot, moist climate of the tropics.

The Bulletin of the Charleston Museum for January contains the report of the director for 1908, which notes the good progress made during the year, especially in the development of the library, which is the only free public library in the city.

The Museum News of the Brooklyn Institute for February notes various advances during the year 1908 and a great gain in attendance, the number of visitors at the Central Museum having been 203,940 and at the Children's Museum 117,182, a total increase of 54,000 over 1907. There is an article on "The Games of the Cliff-Dwellers" and another on the almost lost art of "Scrimshawing." A number of "Additions to the Insect Collection at the Children's Museum" are noted and a list is given of zoological charts for loaning to schools.

SOME of the English Museums from time to time issue extremely good handbooks at astonishingly low prices. A recent publication of this kind is the Handbook to the Weapons of War and the Chase in the Horniman Museum, London, written by H. S. Harrison, curator of the museum, and edited by A. C. Haddon. This book of 73 pages describes a great variety of weapons and includes a list of some of the books and papers on the subject in the Museum Library and sells for twopence, or by post, threepence.

IN the *Report on the Illinois State Museum of Natural History*, Dr. A. R. Crook, the curator, makes a strong plea for the establishment of a museum worthy of the state of Illinois, showing by statistics and illustrations how much has been done by other states and how much may be done in Illinois.

THE RIABOUSCHINSKY EXPEDITION UNDER THE AUSPICES OF THE IMPERIAL RUSSIAN GEOGRAPHICAL SOCIETY[1]

I AM grateful to the society for the opportunity extended to me to give a brief outline of the organization and aims of the Riabouschinsky expedition. In fact, I believe that you are just as much interested in the results to be attained by this expedition as we are in Russia, because a good part of my investigations are to be made on American soil.

The patron of this expedition is Mr. Theodor Riabouschinsky, a well-known capitalist in Moscow. He is a very young man, and during his studies in the Moscow university he paid particular attention to anthropology. He conceived the idea of undertaking a thorough investigation of the Kamchatka Peninsula. The importance of this investigation will be realized when I will tell you that Kamchatka has been under Russian control for about three hundred years and has been visited by many noted travelers, yet very little is known about the country. Up to about fifty years ago Kamchatka was the only open door Russia had to the Pacific Ocean, and at that time the government took some interest in that country; but since the Amour River has been acquired by Russia, the government has neglected that peninsula completely. For this reason the great service rendered to science by a private undertaking will be appreciated.

Mr. Riabouschinsky requested the Imperial Russian Geographical Society to organize at his expense a scientific expedition to Kamchatka. This society organized an expedition consisting of five divisions: Zoological, botanical, geological, meteorological and ethnological. The zoological division is headed by Peter Schmidt, professor at the University of St. Petersburg. He and his four assistants, representing the different branches of zoological science, are to investigate the fauna of Kamchatka. Komaroff, the chief botanist of the Imperial Botanical Garden in St. Petersburg, is the leader of the botanical division. He has four assistants and has to study the flora of Kamchatka and its distribution. The geological division consists of two independent sections—one headed by Krug, a mining engineer, is to study the general geology and topography of Kamchatka; the second section, headed by Konradi of the Russian Geological Survey, is to direct a special investigation of the volcanoes in Kamchatka. The meteorological division, consisting of five members, under the direction of Vlassoff, of the observatory of St. Petersburg, will study the climate of that country. All these four divisions are already on that peninsula, busily engaged in their respective investigations, which, it is presumed, will last about two years.

[1] Paper read at the meeting of the American Ethnological Society, November 9.

The ethnological work was entrusted to the writer of this paper. While accepting the invitation to make this ethnological investigation, I proposed that the area to be studied by my department should be extended so as to include the Aleutian and Kurilian Islands. My reasons were that the northern Kamchadal have already been studied by the Jesup expedition, and the southern Kamchadal are already Russianized to such a degree that archeological work alone, and some relics of the former material culture, can give us some direct indications as to the primitive life of the Kamchadal. Even the somatological work becomes uncertain in many localities where the intermixture with Russians was especially extensive. The position of an ethnologist in Kamchatka should not be judged by the standard of a naturalist who undertakes studies there. While nature has not changed there since the Russians came there, this is not the case with man. The old Kamchadal beliefs, manners and customs are disappearing; some traits, in fact, have already vanished, leaving hardly any traces behind. It seemed to me, therefore, that two years of field work among the Kamchadal alone would not be sufficiently remunerative from a scientific standpoint. On the other hand, the ethnology of the Kamchadal can not be investigated, to any great extent, without the study of the neighboring tribes. The Jesup expedition in its endeavors to clear up the history of the American tribes has already investigated the tribes nearest related to the Kamchadals; I refer here to the Koryak, Chukchee and Yukaghir tribes, as well as to some remotely related tribes, such as the Giliak and Ainu. The nearest neighbors of the Kamchadals in the east are the Aleut. You are undoubtedly aware of the fact that the extreme western Aleutian islands are separated from the eastern shores of Kamchatka by only about three hundred miles, in the center of which are situated the Komandorski islands. And the Aleut have as yet not been sufficiently studied. Even the Jesup expedition has not succeeded in studying this most interesting tribe.

Another object of my study is to investigate the former relations of the Kamchadal to the Ainu. This can only be achieved by a study of the Kurilian islands. In order to attain this, I propose to remain only one year in Kamchatka and to devote the other year of my work to the Aleutian and Kurilian islands. In this manner my work will extend outside of the geographical limits within which the other divisions are working. I decided to spend the first year of my studies among the Aleut. To reach the Aleutian islands I found it advisable to take the western route, by way of America, and on this account my party has had to be separated from the other divisions of the expedition.

Concerning the investigations of the Aleut, I can say the same as I said about the Kamchadal. Under the Russian rule they have been Russianized to such a degree that ethnology has lost considerably. Much, however, can be done even now. We must endeavor to reestablish the past by a study of what remains of their old habits and customs, and their former family and social relations and material culture. It will also be very difficult to define the physical type of the present Aleut, considering the extensive intermixture which has taken place between them and the Russians. But their language is still available for study, and it is important to define the relation of the Aleut language to the Esquimo dialects. It is also important to make new excavations, considering that Dall has found traces of different cultures on the Aleutian islands.

The investigations I plan to make consist essentially in a continuation of my work done for the Jesup expedition. I have in view to contribute to the solution of some problems which have already been raised by the Jesup expedition. It is significant that during the period from 1900 to 1902 I have made investigations on Russian territory on behalf of an American scientific institution, and that I am now on my way to carry on an investigation of the same nature on American territory on behalf of a Russian scientific society. May this serve as an additional proof of the

established adage that science is international in its scope. After all, the results of every scientific investigation become common property, irrespective of the nation which undertakes the work.

My route will be about as follows: At Seattle I will embark on December 8 on the steamer *Pensilvania,* reaching Seward within a week. There I shall take another steamer, the *Dora,* which goes directly to Unalaska. I do not know as yet exactly in what manner I shall travel around the Aleutian islands. At present only three islands are inhabited: Unalaska, Atka and Attu.

But for excavation purposes I must also visit some other islands which are not populated at present, but were so in the past. In the spring of 1910 I expect a Russian naval cruiser to come and take me and my party from the Aleutian islands to the Komandorsky islands, and from there to Petropavlovsk in Kamchatka. Kamchatka I intend to study not only along the coast, but also in the interior. In the north I shall try to reach the bay of Baron Korf, and in the south to go as far as Cape Lopatka. Everywhere I shall endeavor to make excavations of old Kamchadal villages. In the spring of 1911 I hope to return to Russia by way of Vladivostock, visiting on the way some of the Kurilian islands.

My party consists of myself and two assistants, one of whom is my wife, who also accompanied me on the Jesup expedition. Mrs. Jochelson will act in the capacity of both physician and somatologist.

In closing I wish to express for myself, as well as for the Russian Imperial Geographical Society, my gratitude to the governmental and scientific institutions of New York and Washington for the assistance and attention shown me while preparing for my journey. The secretary of the interior has kindly granted me, at the request of the Russian embassy, permission to make excavations on American territory. The secretary of the treasury has promised to issue the necessary orders to take me from the eastern to the western Aleutian islands by revenue cutter. The Smithsonian Institution and other scientific bodies have furnished me with many publications, and maps and also with recommendations, all of which are very valuable to me. The American Museum of Natural History have extended to me their kind hospitality, which I appreciate, and for which I am under obligations to the president and the director of the museum.

WALDEMAR JOCHELSON

ST. PETERSBURG

THE AMERICAN CHEMICAL SOCIETY

THE Baltimore meeting of the American Chemical Society was more largely attended than any previous meeting the society has ever held and was unusually enthusiastic from beginning to end.

The local committee had made special arrangements for the entertainment of the visiting chemists, consisting of banquet and smoker, automobile rides, parties and dinners for the attending ladies, and excursions to Annapolis, to the Maryland Steel Company's works, to the various Baltimore breweries, to Sharp & Dohme's works and to various points of interest around the city. In this respect the city of Baltimore kept fully up to its general reputation for hospitality.

Some four hundred and twenty-five chemists were present and attended the various sectional meetings of the society besides the addresses given in general session.

These general addresses have proved a very attractive feature of recent meetings and those delivered at Baltimore before the whole society were:

"The Untilled Field of Chemistry," by A. D. Little.

"The Use and Abuse of the Ionic Theory," by Gilbert N. Lewis.

"The Work of Werner on the Constitution of Inorganic Compounds," by Chas. H. Herty.

"The Future of Agricultural Chemistry," by H. J. Wheeler.

"The Quantitative Study of Organic Reactions," by S. F. Acree.

"The Classification of Carbon Compounds," by Edward Kremers.

"The Efficiency and Deficiencies of the College-trained Chemist when Tested in the Technical Field," by Wm. H. Nichols.

"To what Extent should College Training Confer Practical Efficiency along Technical Lines?" by Louis M. Dennis.

"The Attitude of Technical Institutions to Post-graduate Study," by Wm. McMurtrie.

To these should be added the retiring addresses

of President M. T. Bogert of the American Chemical Society on "The Function of Chemistry in the Conservation of our Natural Resources," and of H. P. Talbot, vice-president of Section C of the American Association for the Advancement of Science, on "Science Teaching as a Career."

Over one hundred and sixty papers were announced and read before the nine different sections into which the meeting was divided. Many of these papers were of far-reaching interest and the sections were fully attended. It is probable that no one of the sections was more enthusiastic than the recently organized Division of Industrial Chemists and Chemical Engineers, which was in session on four separate days and whose meetings were unusually enthusiastic. The paper of E. G. Bailey, on "Accuracy in Sampling Coal," proved of such great interest to the members that the discussion was allowed to continue for over two hours and the paper of W. H. Walker, describing a new method of quickly finding imperfectly covered spots on tin plate, aroused almost equal discussion and interest among the chemists present.

The Section of Physical and Inorganic Chemistry, the Section of Agricultural and Food Chemistry, the Section of Organic Chemistry and the Section of Fertilizer Chemistry having petitioned the council for permission to organize as divisions of the American Chemical Society the following divisions were authorized and have organized and elected officers: Division of Physical and Inorganic Chemistry, Division of Agricultural and Food Chemistry, Division of Organic Chemistry, Division of Fertilizer Chemistry.

CHARLES L. PARSONS,
Secretary

THE THIRTY-NINTH GENERAL MEETING OF THE AMERICAN CHEMICAL SOCIETY AND THE MEETING OF SECTION C OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE thirty-ninth general meeting of the American Chemical Society and Section C of the American Association for the Advancement of Science was held at the Woman's College in Baltimore from Tuesday, December 29, to Friday, January 1, 1908–9.

On Tuesday morning Section C was organized and this was followed by the opening session of the American Chemical Society. After the general meeting in the afternoon the following addresses were given before the Section of Chemical Education:

The Efficiency and Deficiencies of the College-trained Chemist when Tested in the Technical Field: WILLIAM H. NICHOLS.

To what Extent should College Training Confer Practical Efficiency along Technical Lines: LOUIS M. DENNIS.

The Attitude of Technical Institutions to Post-graduate Study: WILLIAM MCMURTRIE.

This section was well attended and the greater part of the afternoon was spent in the discussion of the papers.

On Tuesday evening a complimentary smoker was given at the Belvedere Hotel by the Baltimore Section of the society. The smoker was preceded by an illustrated lecture on the "Lumiere Process of Color Photography," by William Simon.

On Wednesday afternoon excursions were made through the Naval Academy at Annapolis; through Sharp and Dohme's drug factory, and also the Baltimore breweries.

On Thursday evening a subscription dinner was given at the Belvedere Hotel. This proved to be one of the most pleasant events of the meeting.

On Friday afternoon an excursion was made through the Maryland Steel Works.

On Saturday many of the chemists visited the Bureau of Standards and Geophysical and other laboratories in Washington.

The following addresses were given before the general assembly:

The Function of Chemistry in the Conservation of our Natural Resources: President M. T. BOGERT.

The Untilled Fields of Chemistry: A. D. LITTLE.

The Use and Abuse of the Ionic Theory: GILBERT N. LEWIS.

Science Teaching as a Career: H. P. TALBOT.

The Work of Werner on the Constitution of Inorganic Compounds: CHAS. H. HERTY.

The Future of Agricultural Chemistry: H. J. WHEELER.

The Quantitative Study of Organic Reactions: S. F. ACREE.

The Classification of Carbon Compounds: EDWARD KREMERS.

The following papers were reported before the various sections:

AGRICULTURAL AND FOOD CHEMISTRY

H. J. Wheeler, chairman

Analyses of Milk Products: EDWARD GUDEMAN.

This paper gives comparison of results obtained in the determination of fat, using the standard or official methods and a new method for fat

determination in milk products such as condensed milk, evaporated milk, malted milk, milk powders, milk chocolate, milk cereal products and candies containing milk products or other fats.

The new method suggested is so simplified as to give correct results in the hands of chemists not having special experience in the analyses of such products, besides materially decreasing the time of making analyses. A weighed quantity of the product is dissolved in water or made into an emulsion, the fat and proteids precipitated with copper sulphate, filtered on a fat-proteid free paper, allowed to drain and the damp precipitate on the paper directly extracted with ether. The extracted precipitate is used for making proteid determination by the Kjeldahl method, digesting paper and precipitate. Filtrate from the copper sulphate precipitation is used for determination of sugars and gums. If insoluble starch is present, a weighed filter paper is used and starch determined as difference between total weight of precipitate and proteid and fat found.

Carbohydrates such as starch, dextrines, gums and sugars (cane, maltose, lactose and dextrose) interfere with complete extraction of fat with solvents and in the separation of the fat by the modified Babcock method. Drying the milk product for extraction, direct and after soaking in water, will give low results, due to change in fat during drying (Gudeman, *Proceedings A. O. A. C.*, 1902).

The analyses of milk products containing sugars or cereals or gums are not accurate and it is recommended, therefore, to confine such analyses to the determination of water, ash, fats, proteids, soluble carbohydrates, insoluble carbohydrates and to qualitative examination for starch, dextrine and gum.

The paper reviews the collaboration work done by the A. O. A. C. on condensed milk and evaporated milk during 1907 and 1908.

Effect of Fresh Manure on Denitrification and Plant Growth: E. B. FRED.

This includes the results of field, pot and laboratory experiments with fresh manure containing large amounts of straw. The effect was studied in experiments, where fresh manure was compared with well-rotted manure, with and without the addition of nitrate of soda. The loss due to denitrifying bacteria present in the straw was measured by its effect on plant growth.

The Colorimetric Determination of Nitrates in Soil Solutions containing Organic Matter: W. A. SYME.

Potassium permanganate is added to the hot soil solution, acidified with sulphuric acid, until in excess. The solution is filtered, made alkaline with sodium carbonate and evaporated to dryness on water-bath. The residue is treated with water, filtered and diluted to its original volume. The solution is now ready for the colorimetric determination of nitrates in the usual way with phenol disulphonic acid and ammonia.

There was no nitrate formation by the action of the permanganate on the organic matter.

Change in Composition of Unground Cereals during Storage: SHERMAN LEAVITT and J. A. LECLERC.

Samples of corn, wheat, barley, oats and rye in the unground state were allowed to stand for two years. Every six months samples were drawn for grinding and analysis. The authors found a gradual change in all of the cereals taken. This change becomes more rapid if the samples are ground before aging. The most marked changes are in the content of total sugar, 70 per cent. alcohol soluble proteid, 5 per cent. K_2SO_4 soluble proteid and Stutzer water soluble proteid. Unground corn lost 60 per cent. of its total sugar in two years and its entire germinative power. There was also evidence of a rearrangement of the proteid molecules.

In general corn, barley and oats in the order given were found most subject to a change of sugar content producing a loss. Wheat showed an increase of sugar in two years.

Corn, barley, rye, wheat and oats in the order given show the greatest proteid change.

The Importance of Experience in the Interpretation of the Results of Chemical Analyses: H. H. HANSON.

Incompletely described methods of analysis, unusual variations in materials under investigation, skillful imitations of many important products, and the personal equation of the operator make necessary the most extreme care in interpreting results of chemical analyses. The importance of check determinations with known substances and of repeated trials of unfamiliar methods is illustrated by reference to work upon paris greens, the search for artificial color in various products and examination of maple syrups and sugars and various kinds of vinegars. Unusual variations in the latter are cited and the importance of physical tests emphasized.

Lead Test in Cider Vinegar Analysis: F. A. NORTON.

Attention is called to the varying emphasis given to the lead test in cider vinegar analysis and the reagents employed. The test is shown to be of particular value in the case of a turbidity only being produced on the addition of neutral lead acetate to the vinegar being examined. The turbidity together with failure of the vinegar to give a copious precipitate is due to the presence of the normally insoluble pectinous constituents of the apple marc due to heating either through fermentation or steaming of second pressings or through the employment of badly fermented and heated apples for the manufacture of the vinegar. Increase in the right-handed polarization and of reducing sugars on inversion gives confirmatory evidence as to the presence of second pressings or employment of badly fermented stock. The neutral lead acetate is shown to be more delicate in its reaction than lead subacetate for the lead test, while the addition of alcohol, which is sometimes advocated, is not permissible as alcohol readily precipitates the pectinous bodies causing the turbidity, thus destroying the value of the test.

Normal Occurrence of Boric Acid in Virginia Peanuts: F. A. Norton.

Reference is made to previous work showing the presence of traces of boric acid in apples, pears, quinces, grapes, pomegranates, peaches, gooseberries, cherries, oranges and lemons. Also in hops, radishes, lettuce, carrots and sugar beets, the maximum amount of boric acid normally occurring which has been reported being .016 per cent. Reference is then made to work at the National Canners' Laboratory, showing the normal occurrence of boric acid in two lots of Virginia peanuts, the amount being .015 per cent.

To Determine Fat in Sweetened Condensed Milk: C. E. Cochran.

Weigh out 25 grams of the sample, dissolve in water and make up to 100 c.c. Transfer 6 c.c. to a double-tube milk flask provided with a small-bore tube graduated to give percentage of fat for 5 c.c. milk. Add 4 c.c. of ether and 4 c.c. acetic acid (80 per cent. or more absolute acetic acid). Acetic acid of this strength will dissolve the curd, but has no effect on the sugar. Place the flask in a vessel of warm water and heat until the ether is expelled. A layer of milk fat will now be seen floating on the surface of a clear and colorless liquid. Fill the flask with hot water, thus raising the fat into the graduated tube. The percentage of fat can now be read, the sample whirled in a centrifugal machine and another reading made. Multiply the reading by four.

The Anti-putrescent Effects of Copper Salts: Alfred Springer.

The peculiar behavior of the "certified and inspected milk" from the largest dairy impressed some of the chemists of this city with the belief that some antiseptic had been added to cause this milk to remain sweet. The milk commissioners and owners of the dairy in question indignantly denied that such was the case. After a long series of tests I found small quantities of copper salts present in all the bottles of certified and inspected milk coming from this dairy; furthermore, traced its presence largely to a boiler compound used, containing copper salts, which primed over in the sterilizing room. The milk is especially abnormal in never becoming putrescent, and showing, when exposed to the atmosphere peculiar growths of molds, which are described in the paper.

Experiments to show the anti-putrescent effects of copper salts with meat, egg and blood albumin, sewage and other substances are also described.

The Composition of the Oregon Hop: C. E. Bradley.

A study of typical hop plants with respect to their requirements of the soil gives values for phosphoric acid similar to those reported by Wolff. Nitrogen and potash are, however, less by one half in Oregon samples. Choice fresh hops yield .48 per cent. of oil by steam distillation. The resin content of sixteen commercially graded samples is reported, choice grades giving from 12.32 to 13.75 per cent. soft resin and from 5.35 to 6.59 per cent. hard resin.

The Effect of Low Temperatures upon B. coli and B. typhosus in Sterilized, Artificially Infected Milk: Geo. W. Stiles, Jr.

This investigation involves a bacteriological study of sterilized market milk artificially infected with pure cultures of *B. coli* and *B. typhosus*. Ninety small Erlenmeyer flasks containing 50 c.c. each of the infected milk were placed at ordinary ice-box (53°–63° F.), chilling (30°–34° F.) and cold-storage (— 5°–8° F.) temperatures.

At intervals of three to four days one flask from each lot was removed and the number of colonies determined by plating on plain agar, being incubated four days at 25°–27° C. The initial bacterial content having been determined, the change in numbers varying from this standard are represented diagrammatically.

At ordinary ice-box temperatures the number of organisms, both *B. coli* and *B. typhosus*, multiply

quite rapidly from a few thousand to many millions. Milk infected with *B. coli* did not coagulate within thirty days, except by heating, which was first observed nine days after infection with a bacterial count of 1,000,000,000 per cubic centimeter and acidity of 4 per cent.

Since the investigations are yet incomplete, further conclusions are not deemed advisable at this time.

Abstracts were not received for the following papers:

The Quantity of Copper absorbed in the Process of Greening Vegetables and the Effect thereof on Digestibility: H. W. WILEY and HERMAN SCHREIBER.

The Composition of Concord, Catawba and Scuppernong Grape Juices: H. C. GORE.

A Simple Rapid-process Vinegar Generator for Experimental Purposes: H. C. GORE.

Some Reactions of Coal-tar Colors: C. B. COCHRAN.

Copper Compounds with Protein and their Relative Digestibility: H. W. WILEY and H. SCHREIBER.

Prairie Soil of Unusual Composition: F. J. ALWAY.

The Determination of Essential Oil and Alcohol in Flavoring Extracts: JULIUS HORTVET and RODNEY MOTT WEST.

The Fruit of Medeola Virginica: NICHOLAS KNIGHT and LOIS E. POYNEER.

BIOLOGICAL CHEMISTRY SECTION

J. J. Abel, chairman

Enzymes of Some Lower Fungi: ARTHUR W. DOX.

The enzymes were prepared by growing pure cultures of the molds on a protein-free medium and dehydrating the mycelium by Albert and Buchner's method for "Acetondauerhefe." The *Penicillium* of Camembert cheese was used principally. It was found to contain a protease which digests casein, gelatine and Witte-peptone, but which is without action on ovalbumin, vitellin, fibrin, elastin, edestin and excelsin. Its greatest activity is at the neutral point of methyl orange. It resembles Cohnheim's erepsin and Ascoli's "glutinase." A hippuric acid splitting enzyme was also found which yielded 64 per cent. of the theoretical amount of benzoic acid in twenty-four hours. Two green molds, *Penicillium chrysogenum* Thom and *Penicillium Roqueforti* Thom, both of which answer to Link's description of *Penicillium glaucum*, yielded in the one case 83 per cent. hydrolysis with sodium hippurate and in the other case no hydrolysis at all. Attention is, therefore, called to the necessity of using definitely identified organisms to make chemical experiments of any value. The numerous carbohydrate-splitting enzymes found in fungi by previous investigators were due in part at least to a breaking down of glycogen contained in the mold extract.

Some of the Fermentative Properties of Bacteria: D. H. BERGEY, M.D.

In a previous paper[1] I reported on a number of bacteria studied by myself and Dr. Deehan with regard to the fermentation of saccharose, dulcite, adonite and inulin. These carbohydrates were employed because the work of MacConkey indicated that they were of primary importance in the differentiation of bacteria belonging to the *colon ærogenes* group. Subsequent study with regard to the fermentative properties of these bacteria on other carbohydrates demonstrated that an organism without fermentative properties for these four carbohydrates might still not compare with others of similar properties with regard to other carbohydrates. Detailed study has shown that lactose, sorbose, raffinose and dextrin are also of primary importance in the differentiation of this group of bacteria.

I have attempted to ascertain some law concerning the fermentative properties of these bacteria to assist in explaining why one carbohydrate should be acted upon by a particular organism and another carbohydrate of related structure left intact. According to the teaching of Fischer and others, ferments can break up only those carbohydrates that have one or more asymmetrical groups, and in the light of Fischer's teaching the ferment must correspond in configuration to the carbohydrate on which it is acting, in a way similar to the relation of a key to the lock which it opens. We must conceive then that the ferment must likewise possess one or more asymmetrical groups so as to correspond to the configuration of the carbohydrate, or to be enabled to link on to the carbohydrate molecule to form a new chemical combination.

My studies have failed to disclose any constant relation between the carbohydrates fermented by closely related bacteria, and hence no law by which one could foretell what action a certain microorganism might have on the different carbohydrates.

Abstracts have not been received for the following papers:

[1] *Journal of Medical Research*, Vol. XIX., p. 175.

The Indirect Colorimetric Estimation of Small Amounts of P_2O_5 with Uranium Acetate and Potassium Ferrocyanide: R. B. GIBSON.

Factors which Influence the Determination of Kreatinin: F. C. COOK.

On the Oxidation of Carbon Monoxide: J. H. KASTLE.

The Relations of Magnesium and Phosphorus to Growth in the Fungi: HOWARD S. REED.

Is Platinum Black Capable of Effecting the Hydrolysis of Ethyl Butyrate? A. S. LOEVENHART.

The Absorption and Partial Purification of Catalase from Liver: A. W. PETERS and H. W. STEWART.

The Diastatic Enzyme of Ripening Meat: A. W. PETERS and H. A. MATTILL.

The Influence of the Isomers of Salicylic Acid on Metabolism: E. W. ROCKWOOD.

Surface Tension as a Factor in the Distribution of Salts in Animal and Vegetable Cells: A. B. MACALLUM.

Esterification of the Bile Acids: ISAAC KING PHELPS.

Estimation of Total Sulphur: ISAAC KING PHELPS.

A Study of Nylander's Reaction: M. E. REHFUSS and P. B. HAWK.

The Determination of Iodine in Protein Combinations: L. W. RIGGS (by invitation).

A Distributing Factor in Barfœd's Test: WILLIAM H. WELKER.

DIVISION OF INDUSTRIAL CHEMISTS AND CHEMICAL ENGINEERS

A. D. Little, chairman

The Munroe Crucible: WALTER O. SNELLING.

The use of platinum felt as the filtering medium in a crucible of the Gooch pattern was first suggested by Professor Charles E. Munroe, in an article entitled "Filtration with Filters of Metallic Felt" published in the *Journal of Analytical Chemistry*, Vol. 2, part 3, July, 1888.

Crucibles prepared by the method suggested by Professor Munroe have many advantages not possessed by any other type of apparatus used for filtration. These filters retain the finest precipitates, and owing to the fact that no other material than platinum enters into the construction of the filter, no impurity other than this metal can contaminate the filtrate, and thus in very exact work a very great advantage is gained through the use of the Munroe crucible.

A series of tests were described, showing that the porosity of the mat of the Munroe crucible was many times greater than that of the asbestos mat in crucibles of the usual type. The preparation of the crucible was described, and a number of experiments were mentioned showing the wide range of applications for which the crucible was suited, and the many classes of work in which it has been found to be superior to other types of filtering apparatus.

The Rapid Determination of Moisture in Commercial Products of a Viscous or Semi-solid Consistency: ARTHUR LOWENSTEIN.

The author states that "the method employed consists merely in the application of several well-known principles, viz., the addition of a dehydrating agent of a lower boiling point than water, in which the material to be desiccated is wholly or in part soluble, or at least miscible. The reagent employed is ordinary 95 per cent. ethyl alcohol. In the case of materials containing soluble proteins, the alcohol acts in some cases as a coagulant, and in others as a precipitant, which action facilitates the drying process. A definite quantity of the material is weighed into a metal dish, 2½ inches in diameter, together with a short glass stirring rod, 15 c.c. of alcohol added; stirred thoroughly; evaporated on steam bath; another portion of alcohol added and similarly evaporated. Dish then transferred to jacketed oven at 105° C. and dried to constant weight. Total period of drying, 1½–2½ hours. Table gives results of tests on meat extracts, concentrated glue solutions, concentrated tank water, inspissated ox gall, dyewood extracts, syrups, various kinds of cheese, etc.

An Unusual Incrustation on Generator Coils: E. H. EHRENFELD.

On the generator coils of a refrigeration plant of the absorption type there was formed a hard, semi-crystalline scale about one sixteenth of an inch thick. Its texture was very compact, its density 5.117, and on being tapped it gave almost a metallic sound.

It was formed on the outside of two-inch iron pipes through which steam circulated. The pipes were surrounded by strong aqua ammonia, and it was from this ammonia that the scale was deposited. A part of the circulation system having been constructed of galvanized iron, zinc was taken up by the ammonia and the scale deposited therefrom contained over 90 per cent. of zinc oxide.

Abstracts have not been received for the following papers:

Rapid Analysis of Babbitt Metal: PERCY H. WALKER and H. A. WHITMAN.

The Unsaponifiable Matter in the Oleo-resins of Conifers: CHAS. H. HERTY and W. S. DICKSON.

Acceleration Tests of the Resistance to Corrosion of Iron and Steel: ALLERTON S. CUSHMAN.

The Changes in Crude Petroleum Effected by Diffusion through Clay: DAVID W. DAY.

Further Remarks on Vanadium and its Estimation: GEORGE AUCHY.

Iron, from a Chemical and Commercial Standpoint: PAUL N. CLANCY.

An Unusual Incrustation on Generator Coils: C. H. EHRENFELD.

Principles Underlying Efficient Grinding and Separating: W. H. WALKER.

The Purchase of Material on Specification: H. J. SKINNER.

Some Industrial Applications of the Ives Colorimeter: F. A. OLMSTEAD.

Factors determining the Efficiency of Trolley Wires: C. F. WOODS.

The Iodine Number and some other Values for China Wood Oil: E. W. BOUGHTON.

Accuracy in Sampling Coal: E. G. BAILEY.

The Storage of Beef at Temperatures above the Freezing Point: W. D. RICHARDSON.

Observations on the Freezing Out of Colloids with Reference to Frozen Meats: W. D. RICHARDSON.

Observations on Certain Stains applied to Frozen and Unfrozen Muscular Tissue: W. D. RICHARDSON.

Frozen Poultry: W. D. RICHARDSON.

Observations on the Best Methods of Cold Storage: W. D. RICHARDSON.

The Commercial Manufacture of Amorphous Calcium Phosphide: CHARLES E. MUNROE.

The Distribution of Nitrate of Soda in the United States: CHARLES E. MUNROE.

Standard Methods for Determining and Recording the Relative Permanency or Resistance of Coloring Matter to the Common Color Destroying Agencies: L. A. OLNEY.

Standardization of Methods for Commercial Analysis of Fats, Greases, etc., and Adoption of Rational Nomenclature for Same: A. G. STILLWELL.

Guayule and Guayule Rubber: THEODORE WHITTELSEY.

Lubrication and Lubricants: C. F. MABERY.

FERTILIZER CHEMISTRY SECTION

F. B. Carpenter, chairman

Some Points of Interest in Connection with Present Fertilizer Laws and Proposed Fertilizer Legislation: ARTHUR LOWENSTEIN.

The author first indicates the points which are at present uniform in the various state fertilizer laws. He next points out in detail the lack of uniformity in these laws, and states that this is due not so much to lack of uniformity in the basic principles of the laws, but rather in the elaboration of the principles, and the mode of expression of the details. Quotations are made from the 1907 report of the Committee on Fertilizer Legislation of the A. O. A. C., in which this committee favors national fertilizer legislation, after certain specified difficulties have been overcome. The point next discussed is, if a national law were enacted, whether it would bring about the harmony and uniformity desired or not. The author points out why, in his opinion, it would not. He proposes a uniform state fertilizer law and recommends that a committee be selected by the Division of Fertilizer Chemists of the American Chemical Society to confer with similar committees from the A. O. A. C., National Fertilizer Association and the Association of Agricultural Colleges and Experiment Stations, with a view to drafting a uniform state fertilizer bill—all parties concerned being represented on this joint committee. Then if a national law is desired or necessary for the control of interstate commerce, work for the adoption and passage by congress of this uniform law.

Potash Experiments in Factory Work showing Heavy Loss by Official Method and Possible Means of Preventing this Loss: J. E. BRECKENRIDGE.

A brief history of the work of the Association of Official Agricultural Chemists on potash during recent years, showing loss of potash by official method.

Methods used to find this lost potash explained with results on thirteen samples. Some methods used:

No. 3. (*a*) Same as Carpenter method, except 1 per cent. citric acid solution was used for solvent instead of 5 c.c. HCl in 300 c.c. water.

No. 11. Washed 2 grams on 11 cm. filter with small portion of hot water into a 200 c.c. flask to about 175 c.c., when no chlorid or soluble sulphate should be left in residue on filter. Add .6 gram citric acid to flask, heat contents of flask to boiling, add ammonia and ammonium oxalate and proceed as in official method.

No. 12. Same as No. 11, only use 3 c.c. HCl in place of .6 gram citric acid.

No. 13. Same as No. 11, only do not add any citric acid.

Abstracts have not been received for the following papers:

The Fertilizer Industry—An Historical Sketch: F. B. CARPENTER.

A Comparison of Various Methods in bringing about the Solution of Potash in Mixed Fertilizers and Tobacco Stems: M. H. PINGREE.

A Discussion of Methods for Determining the Availability of Phosphoric Acid in Thomas Phosphate Powder: GEO. D. LEAVENS.

A Discussion of Methods for the Determination of Iron and Alumina in Phosphate Rock: F. P. VEITCH.

Note on the Determination of Insoluble Phosphoric Acid: F. B. CARPENTER.

Chemistry and Geology of the Inland Phosphates of the United States: LUCIUS P. BROWN.

Loss of Potash in Commercial Fertilizers: F. B. PORTER.

Remarks on the Gladding Method for Phosphoric Acid (weighing direct the phospho-molybdate precipitate): A. G. STILLWELL.

PHARMACEUTICAL CHEMISTRY SECTION

Edward Kremers, chairman

Determination of Acetanilid in Hydrogen Peroxide Solutions: ELWYN WALLER.

In a side neck flask of 200 c.c. capacity, place about half a stick of caustic potash or soda (6 to 7 grams). Add about 20 c.c. of water to dissolve, and then 25 to 30 grams of granulated metallic zinc. Then add a measured amount, not over 50 c.c. of the solution to be tested. Connect the flask on the one side with a flask to supply steam, arranging the tube to deliver steam near the bottom of the solution; connect on the other side with a condenser. The condenser should deliver into a Peligot bulb tube or some other arrangement by which the distillate is immediately brought in contact with moderately strong hydrochloric acid.

Raise the heat on the flask slowly, and when nearly half of the contents have distilled over, start the steam to passing through. The end of the distillation is a matter of guess. When the anilin is coming over in quantity, fumes are to be seen in the receiver, but for the last portions they can not be seen. When it is judged that all has come over, detach the receiver and catch what comes over later in a fresh receiver or a beaker, and titrate it separately.

To prepare the volumetric bromine solution, dissolve 25 grams of caustic potash in 20 to 40 c.c. of water, cool, and add liquid bromine until it appears supersaturated. Then dilute to about 200 c.c. and boil out excess of bromine (judged by the color). Cool, and dilute to one liter. This should give a solution of which 1 c.c. = nearly 0.01 gm. acetanilid. Standardize by means of a solution containing 0.5 gm. acetanilid in 200 c.c. of water, using 30 to 50 c.c. lots at a time, treated either by distillation on the manner above given, or by boiling with strong hydrochloric acid. Either method was found to give the same result with the same amount of acetanilid.

The method was tested by first distilling known quantities of the sample and titrating the distillate, then adding known amounts of acetanilid to the same quantities of the sample, and distilling. The distillates took just the additional amount required by the acetanilid added.

The presence of acetanilid was indicated by obtaining the isonitril reaction on the original sample.

Recent Developments in Preparations for Administering Sulphur: ELWYN WALLER.

This paper discusses the reasons why attempts are being made to obtain sulphur in an unoxidized but soluble condition. The therapeutic effects of sulphur seem to be inversely proportional to the degree of oxidation.

Sulphur in solid form does not lend itself readily to absorption. The ordinary solvents of sulphur have therapeutic effects of their own and are not desirable for use.

Lac sulphuris leaves much to be desired. These facts have caused the appearance of preparations of colloidal sulphur. It is claimed these are the equal of lac sulphuris and are soluble in water.

Analysis of two such preparations are as follows (results were in grams per 100 c.c.):

Total sulphur	3.05
Lime	1.51
Residue on evaporation	4.94

Lime appeared to be the only base, and no sulphate was present, the sulphur was probably present as in the lac sulphuris.

A second sample soluble in water contained sulphur probably as sodium sulphite. This sample contained resin probably as solvent for the sulphur. The presence of hydrogen sulphide could not be established in either sample.

Abstracts have not been received for the following papers:

The U. S. P. Method for Making Precipitated Sulphur: EDWARD KREMERS.

The U. S. P. Test for Petroleum in Turpentine Oil, and the New Process Oils: EDWARD KREMERS.

A New Method for Alkaloidal Determinations with Mercuric Potassium Iodide: G. HEIKEL.

INORGANIC CHEMISTRY SECTION

Charles H. Herty, chairman

Denudation in the United States: R. B. DOLE and H. STABLER.

This paper presents computations of the rate at which the earth's crust is being moved as solid particles carried in suspension by streams and as matter carried in aqueous solution. The computations are based on twenty years' stream gauging work at 1,500 stations and about 5,000 water analyses by the Water Resources Branch of the U. S. Geological Survey, supplemented by stream gauging data of the Engineer Corps, U. S. A., and the Weather Bureau and by some miscellaneous analyses from state and municipal reports. Except the estimates for the Northern Pacific, Great Basin and Hudson Bay areas, for which the data are rather meager, the figures are believed to be within twenty per cent. of the correct average values. Estimates for over one hundred secondary drainage basins were computed.

If denudation in the Great Basin is taken as zero, the figures for the entire United States are as follows: Tons of solids removed per square mile per year, dissolved, 87; suspended, 166; amounting to a total of 270 million tons of dissolved and 513 million tons of suspended matter per year; equivalent to 1,330 millionths of an inch per year, or one inch in 760 years.

A Spectroscopic Method for Determining Small Amounts of Lithium: W. W. SKINNER.

The separation and determination of lithium, when present in very small amounts, or when the ratio of sodium and potassium to lithium is high, are accomplished with very considerable difficulty. This method proposes the use of the spectroscope under definite conditions for this purpose, the idea being that the brilliancy and length of duration of the lithium spectrum are, within certain limits, proportional to the quantity of material introduced into the flame.

Classification of the Elements for Arranging References to Articles: A. L. VOEGE, Concilium Bibliographicum, Zurich, Switzerland. (Presented by W. C. Bray, Massachusetts Institute of Technology, Boston.)

Mr. Voege has been engaged for a number of years in adapting the Dewey system of classification to the subject of electro-chemistry. He desires to use a classification of the chemical elements that will be satisfactory to chemists, and is anxious to receive expressions of opinion from the American Chemical Society and its individual members on the four different classifications which he has prepared. In two of these the elements are separated into metalloids and metals; in the other two the ordinary periodic system, and the Werner periodic system, respectively, are followed. After considerable discussion, the matter was referred to the council of the society. Circulars describing the different arrangements, which arrived too late for distribution at the meeting, may be obtained from Mr. Bray.

Abstracts were not received for the following papers:

Preliminary Note on a New Volumetric Method for the Determination of Cerium in the Presence of other Rare Earths: F. J. METZGER.

Standards of Volumetric Analysis: LAUNCELOT W. ANDREWS.

The Iodometric Determination of Sulphates and that of Sulphur in Coal or in Organic Compounds: LAUNCELOT W. ANDREWS.

The Supposed Presence of Iodate in Commercial Potassium Iodide—an Illusion: LAUNCELOT W. ANDREWS.

Erbium and its Companions (preliminary paper): CHARLES JAMES.

The Transformation of other Forms of Carbon into Graphite: WILLIAM C. ARSEM.

Electrolytic Estimation of Lead, using the Mercury Cathode: M. HUME BEDFORD.

A Method for the Preparation of Standard Hydrochloric Acid: G. A. HULETT and W. B. BANNER.

The Atomic Weight of Lithium: THEODORE W. RICHARDS and HOBART H. WILLARD.

The Basic Nitrates of Magnesium: CHARLES L. PARSONS and GEO. A. PERLEY.

Barium Sulphate in Analysis in the Munroe Crucible: ISAAC KING PHELPS.

The Weight of Carbon Dioxide with a Table of Calculated Values: S. W. PARR.

Ferric Nitrates in Aqueous Solutions: F. K. CAMERON and W. O. ROBINSON.

Review Phosphate Situation: F. K. CAMERON and J. M. BELL.

ORGANIC CHEMISTRY SECTION

S. F. Acree, chairman

Preparation of Benzophenone: J. BISHOP TINGLE and W. W. HOLLAND.

It is well known that the interaction of gases at moderately high temperatures is largely influenced by apparently small variations in the physical state of the containing vessel. These effects

are usually described as "catalytic," but it is obviously very difficult in many cases to distinguish between a "catalytic" influence and one due only to an alteration in the thermal properties of the surface of the container. In the hope of throwing some light on the subject we have investigated the production of benzophenone by the distillation of calcium benzoate in a current of carbon dioxide. The calcium salt was mixed intimately with the substances mentioned below, the figures give the percentage yield of benzophenone. Unglazed porcelain, 30.4; carbon from arc light rods, 40.9; iron filings, 45.0; calcium carbonate and iron filings, 54.5; calcium carbonate and arc light rods, 50.0. These results are the mean of closely agreeing duplicates and express the yield percentage of the theoretical. The yield of benzophenone from benzene, aluminium chloride and benzoyl chloride is 42.8 per cent., according to Gattermann.

Studies in Nitration—VI., Synthesis of Certain Nitranilides: J. Bishop Tingle and C. E. Burke.

Work is in active progress on the synthesis of a number of nitrophenylamides, nitrophenylimides and nitrophenylamidic acids from *o*-, *m*- and *p*-nitraniline. In this manner it is hoped to identify some of the many compounds prepared by the senior author and Dr. F. C. Blanck by the nitration of the corresponding aniline derivatives. A description of the individual compounds thus far synthesized will appear in due course.

Aniline Derivatives of Certain Unsaturated Dibasic Acids of the Aliphatic Series: J. Bishop Tingle and S. J. Bates.

It has been shown by the senior author and his collaborators that succinanilic acid, $C_6H_5NHCOCH_2CH_2CO_2H$, when treated with aniline yields succindianilide, $C_6H_5NHCOCH_2CH_2CONHC_6H_5$, whereas phthalanilic acid, $C_6H_5NHCOC_6H_4CO_2H$, under similar conditions is converted into the anil,

$$C_6H_4\left\langle\begin{matrix}CO\\CO\end{matrix}\right\rangle NC_6H_5.$$

The investigation has now been extended to the aniline derivatives of maleic, fumaric and malic acids. Several new compounds have been prepared. A study is being made of the action of various amines on fumar-, male- and malanilic acids,

$$\begin{matrix}HCCO_2H\\ \because\\ C_6H_5NHCOCH\end{matrix}\quad,\quad\begin{matrix}HCCO_2H\\ \because\\ HCCONHC_6H_5\end{matrix}$$

and $C_6H_5NHCOCH(OH)CH_2CO_2H$, respectively.

Rearrangement in the Phthalamidic Acid Series—IV.: J. Bishop Tingle and B. F. Pablett Brenton.

The work of Bishop Tingle and his collaborators on this subject has been extended. Phthaldiphenylamidic acid, $(C_6H_5)_2NCOC_6H_4CO_2H$, when heated with pyridine at 100° gives *dipyridinium phthalate*, in 109°. Aniline transforms the acid into phthalanil,

$$C_6H_4\left\langle\begin{matrix}CO\\CO\end{matrix}\right\rangle NC_6H_5,$$

whereas by the action of β-naphthylamine a mixture of phthalanil and phthal-β-naphthylamidic acid, $C_{10}H_7NHCOC_6H_4CO_2H$, is obtained. The following new acids have been prepared by the method described recently by Bishop Tingle and Rolker.[1] A study is being made of the action on them of various amines. *Phthalphenyl-β-naphthylamidic acid*, $C_6H_5N(C_{10}H_7)COC_6H_4CO_2H$, m. 115°. *Phthal-p-chlorphenylamidic acid*, $ClC_6H_4NHCOC_6H_4CO_2H$, m. 180°. *Phthaldiisobutylamidic acid*, $[(CH_3)_2CHCH_2]_2NCOC_6H_4CO_2H$, m. 153°. The product from diisoamylamine was tarry. Ethylaniline and methylaniline yielded the diamides $C_6H_4[CON(C_6H_5)C_2H_5]_2$ and $C_6H_4[CON(C_6H_5)CH_3]_2$, respectively, m. 144° and 181.5°. Two compounds have been prepared from benzidine and phthalic anhydride, both melt only at high temperatures. One appears to be the diamide or imide,

$$C_6H_4\left\langle\begin{matrix}CO\cdot NH\cdot C_6H_4\\CO\cdot NH\cdot C_6H_4\end{matrix}\right.,$$

or

$$C_6H_4\left\langle\begin{matrix}CO\\CO\end{matrix}\right\rangle NC_6H_4\cdot C_6H_4NH_2.$$

The other has not yet been investigated. *p*-aminobenzoic acid gives the *dibasic acid*, $HO_2CC_6H_4CONHC_6H_4CO_2H$, m. 271°.

The action of carbamide and its substitution products on phthalic anhydride has been made. It is found to take place according to the equation,

$$\begin{matrix}CO\\CO\end{matrix}C_6H_4\langle\rangle O + RHNCONH_2$$

$$\rightarrow C_6H_4\left\langle\begin{matrix}CO\\CO\end{matrix}\right\rangle NR + NH_3 + CO_2.$$

The compounds produced when $R = H$, C_6H_5, $C_6H_4CH_3$, CH_3 and C_2H_5 have been investigated. Phenythiocarbamide behaves in a similar manner, NH_3 and COS being evolved. Ethylidenecarbamide

[1] *Jour. Am. Chem. Soc.*, 30, 1882, 1908.

gives a tar. Form-β-naphthylide and phthalic anhydride yield formic acid and phthal-β-naphthylimide.

The Synthesis of Orthohydroxyazobenzene: Wm. McPherson and H. J. Lucas.

The synthesis of orthohydroxyazobenzene by the saponification of the compound obtained by the action of unsymmetrical benzoyl phenylhydrazine on orthobenzoquinone was described. The bearings of this synthesis on the constitution of the orthohydroxozo compounds was also discussed.

Occurrence of Diterpenes in Camphor Oil: Alfred Hoffman.

The so-called "blue, thickened" camphor oil of commerce, which consists of the highest boiling parts of camphor oil, contains in its highest fraction a few per cent. of a hydrocarbon $C_{20}H_{32}$. Purified by distillation over metallic sodium, it is a colorless, mobile liquid of faint odor and the following physical properties: b. 20 mm. = 195–205°, b. 760 mm. = 315–320° with slight decomposition, $a_D = +6° 49'$, $d\,24° = 0.902$, $n_D = 1.5024$, molecular refraction for $C_{20}H_{32}$ with three double bonds, found 88.94, calculated 88.77. This would point to its being bicyclic. It does not resinify on standing, can be distilled with steam and is unsaturated toward potassium permanganate and bromine, adding about six atoms of the latter. This seems to be the first instance of a hydrocarbon with such a high boiling-point being found in a natural essential oil.

The Condensation of Acetone with Calcium Oxide: Alfred Hoffman.

The formation of mesityl-oxyd, isophoron and the xylitons from acetone under the influence of calcium oxide has been studied by a number of chemists and the constitution of the products established. The present article deals with the mechanism of the reaction. Briefly, it was found that the simplest condensation product, mesityl-oxyd, was formed first, and from it alone or with acetone the more complicated ones. It was also shown that the first step in the reaction in all cases is an aldol condensation under the influence of the small quantities of calcium hydroxide usually present as impurity. Then water is split off to form the known condensation product. Thus, with perfectly pure calcium oxyd no condensation takes place, even on heating under pressure. In the simplest case, that of acetone to mesityl-oxide, the intermediate product could be isolated and was shown to be the alcohol diacetone which has already been described as a product of the action of alkalies on acetone.

5-Brom-2-Aminobenzoic Acid: Alvin S. Wheeler.

Trichlorethylidene-o-aminobenzoic acid on bromination in glacial acetic acid gives a high yield of 5-brom-2-aminobenzoic acid which is converted into the free base by water. Direct bromination of anthranilic acid under like conditions gives a less pure product. A detailed comparison of the two methods will soon be completed.

Fixation of Labile Hydrogen Atoms by Chloral: Alvin S. Wheeler and Strowd Jordan.

The condensation of chloral with primary aromatic amines gives compounds of the type $CCl_3CH(NHPh)_2$. Substituted amines may be used, but these are limited to those containing not more than two negative elements or groups in the benzene nucleus. All such compounds on bromination split off chloral and give brominated amines. A quantitative study is being made, comparing this method with the direct bromination of amines. The reactions proceed best in glacial acetic acid.

The Anhydride of Chlorterephthalic Acid: John E. Bucher.

This acid easily forms an anhydride $(C_8H_3ClO_3)_x$ on treatment with acetic anhydride. Molecular weight determinations indicate that the value of x is very high.

The Oxidation of 1-Phenylnaphthalene Derivatives to Benzenepentacarboxylic Acid: John E. Bucher.

A number of anhydrides obtained by the action of acetic anhydride on phenylpropiolic acid were oxidized to benzenepentacarboxylic acid. This reaction shows that they are derivatives of 1-phenylnaphthalenedicarboxylic anhydride. In the final oxidation which was carried on in fuming nitric acid, it was necessary to use manganese nitrate as a catalytic agent.

Abstracts have not been received for the following papers:

Studies in Catalysis: S. F. Acree.

Studies in Tautomerism: S. F. Acree.

The Alkylation of Tautometric Acids: Sidney Niedlinger.

The Catalytic Formation of Esters from Amides and Alcohols in the Presence of Acids: E. E. Reid.

The Catalytic Hydrolysis of Amides by Acids and Alkalies: E. E. Reid.

On the Determination of Halogens in Organic Compounds: C. W. Bacon.

Rearrangements in the Camphor Series: Isocampholactone: W. A. Noyes and A. W. Homberger.

The Addition of Acetic Acid to Unsaturated Hydrocarbons: EDWARD KREMERS.

The Esterification Law and Steric Hindrance Hypothesis: M. A. ROSANOFF and W. L. PRAGER.

A New Method for Detecting Mutarotation: C. S. HUDSON.

Alkylation of Cyanacetic Ether: JOHN C. HESSLER.

The Theory of Indicators and the Reactions of Phthaleins and their Salts: E. A. SLAGLE.

The Mechanism of Oxime Formation and Hydrolysis: L. JUNIUS DESHA.

The Determination of Acid Radicals in Esters of Cellulose: R. G. WOODBRIDGE, JR., and F. J. MOORE.

The Condensation of Nitromalonic Aldehyde with Urea: WILLIAM J. HALE.

Some New Terpine Derivations: GEO. B. FRANKFORTER.

The y-y'Diketonic Acids: J. B. GARNER.

Further Studies in Catalysis in Ester Formation: ISAAC KING PHELPS.

Removal of Plant Food from Soil by Plants: F. K. CAMERON and J. G. SMITH.

PHYSICAL CHEMISTRY SECTION

Gilbert N. Lewis, chairman

The Behavior of the Nickel Anode: E. P. SCHOCH.

Starting at the equilibrium potential of nickel in neutral nickel sulphate solution, and polarizing anodically with gradually increasing current densities, the author found that nickel showed what may be called "normal" anodic behavior with very small current densities, but that with larger current densities the active surface appears to be diminished. This diminution of the active surface is due to the discharge of oxygen; and the whole behavior of the nickel anode with large current densities is due to the relation of the areas of the active to the impaired spots. This presents the phenomenon of porosity in a new light.

The Temperature Coefficient of the Conductivity at Infinite Dilution: JOHN JOHNSTON.

Value of Λ_0 at a series of temperatures ranging between 0° and 156° were obtained for a number of salts by extrapolating with the aid of the function $1/\Lambda = 1/\Lambda_0 + K(C\Lambda)^n$, values of n being chosen so that the graphs were nearly linear. From these were derived values of l, the mobilities of the separate ions. On plotting the values of log l at the various temperatures against the logarithms of the numerical values of the fluidity of water at the corresponding temperatures, straight lines were obtained for all the ions investigated, with the exception of H^+ and OH^-, where, indeed, abnormality might be expected, as these two ions occupy a quite especial position when water is the solvent. For the others (thirteen in number, including uni-, di-, tri- and quadrivalent ions), the derivations from linearity are not greater than the error of the separate determinations. Thus this method presents a very convenient means of obtaining the value of l at any intermediate temperature, or of calculating its temperature coefficient, since the temperature coefficient of the fluidity of water is known and may be expressed by a fairly simple formula.

The Change in Refractive Index with Temperature—I.: K. GEORGE FALK.

The refractive indices for the three hydrogen and the sodium lines and the density of diisoamyl, n-heptyl alcohol, benzyl alcohol, dimethylaniline, n-butyric acid and acetylacetone were determined at a large number of temperatures between 20° and 70°. The variation was found to be a straight line function of the temperature for all. The change in the refractive powers, using the expressions $n^2 - 1/d$, $n - 1/d$, $n^2 - 1/(n^2+2)d$, were also calculated. Ethyl acetate gave results indicating a change in the equilibrium between the tautomeric forms at higher temperatures.

A Modified Oxyhydrogen Gas Coulometer: J. W. TURRENTINE.

The Walter-Neumann, single tube, oxyhydrogen gas coulometer, with adjustable leveling tube, has been modified, so that the platinum electrodes, in the old form fastened to a short length of platinum wire which was sealed in the glass walls of the coulometer and terminated on the outside in a small loop, are sealed in glass tubes and are inserted into the coulometer through rubber stoppers held in side arms.

Objectionable features of old form: (1) Electrical connection was made with coulometer by hooking wires in the loops. This gave poor contact and high local resistance and (2) consequent heating which caused alternate expansion and contraction, and soon resulted in the cracking of the glass and the breaking out of the electrodes, (3) or the platinum loops soon broke off. (4) In either case the apparatus became useless and the platinum electrodes had to be discarded.

Advantages claimed for the modified form: (1) Electrodes are adjustable and (2) may be removed and cleaned. (3) Due to the elimination of the fragile seal in the wall of the main tube, the apparatus is more durable. (4) In case of breakage, the platinum parts are not "scrapped," but are transferred to a new tube. This requires the

purchase in such a case of glass parts only. (5) Electrical connection is made through a length of copper wire. Good contact may then be got by means of screw connectors.

The Rapid Precipitation of Metals on Gauze Cathodes with Fixed Electrodes: JOHN T. STODDARD.

Cadmium, copper, nickel, silver, zinc and probably other metals may be quantitatively precipitated for their solutions upon a fixed gauze cathode, with a fixed anode in about the same time as that required when rotating electrodes are employed. The current used is about the same as in the latter method.

The cylindrical cathode, 3 cm. in diameter and 3 cm. high, is made of platinum gauze, described by the maker as 52-mesh and made of 0.004 inch wire. Its total surface is calculated to be about 40 sq. cm. The anode is a cylinder of platinum foil, about 2.5 cm. high and of a diameter which may vary between 0.5 and 1.2 cm.

It is placed concentrically within the gauze cathode. The electrolysis is carried out in a 80 c.c. beaker with about 50 c.c. of solution, in order to gain the advantage of concentration. The current strength may vary within wide limits in most cases without influencing the character of the deposits, but the time is greatly shortened only when comparatively high currents are used.

It appears that the more or less troublesome and expensive arrangements for rotating one of the electrodes, or of agitating or rotating the solution by mechanical means or by the use of a magnetic field are quite unnecessary for rapid and complete precipitation.

The character of the deposited metals is excellent, and entirely satisfactory analyses have been made by the method described above.

The Rapid Precipitation of Metals in a Mercury Cathode with Fixed Anode: JOHN T. STODDARD.

Cadmium, copper, nickel, silver, zinc and probably other metals can be precipitated in a mercury cathode with a fixed anode in substantially the same time as that required with the use of a rotating anode. The anode is a flat spiral of platinum wire, and it is placed 1.05 cm. from and parallel to the surface of the mercury in a 50 c.c. beaker. The cathode connection is made by a platinum wire, which is protected from the solution by a small glass tube sealed to it 2–3 mm. from the end, which dips into the mercury.

The solution may have any volume from 10 c.c. to 30 c.c. The strength of current is limited only by the danger of loss from too violent boiling of the solution. About 40 g. of mercury are used as cathode.

The following table shows the time necessary for complete precipitation of the metals:

Metal	Approx. Amount	Current Strength	Time in Minutes
Cadmium	0.21 g.	5 Amp.	10
Copper	0.4	4	8
Nickel	0.2	6	12
Nickel	0.5	7	15
Silver	0.5	8	7
Zinc	0.4	6	15

Analyses made by this method give satisfactory results, concordant with those made from the same solutions with gauze cathode and fixed anode.

Some New Laboratory Apparatus: JOHN T. STODDARD.

1. The wire-test-tube holder, described by the writer in the *Journal of Analytical Chemistry*, January, 1890, is used as the clamp on a light stand. The clamp is adjustable at any angle and up to 10½ inches in height above the table. The support is well adapted to many services in the laboratory and has great stability from the special design of its base.

2. A funnel support which fits on the above stand consists of circular plate of aluminium with openings for the reception of four funnels. The special base of the stand insures stability for a much greater load than the funnels when full of solution. Its chief advantage is compactness.

3. A wire dish holder, which grasps an evaporating dish by the edge and holds it securely.

Abstracts have not been received for the following papers:

A New Method of Determining the Partial Vapor Pressures of Binary Mixtures: M. A. ROSANOFF and ARTHUR B. LAMB.

On the Partial Vapor Pressures of Binary Mixtures: M. A. ROSANOFF and C. W. EASLEY.

Recent Evidence for the Existence of Hydrates in Aqueous Solutions: H. C. JONES.

A New Law concerning the Vapor Pressures of Binary Mixtures: M. A. ROSANOFF.

On the Duhem-Margules Equation as applied to Binary and Ternary Mixtures: WILLIAM EDWARD STORY.

Preparation of Pure Hydrogen and the Elimination of Oxygen: GEO. A. HULETT.

A Maximum Volt Meter: W. LASH MILLER.

The Relations between Viscosity and Fluidity: EUGENE C. BINGHAM.

A New Method of Measuring Association by Means of Fluidity Data: EUGENE C. BINGHAM.

A Simplification of the Cyclical Process Method for Deriving Thermodynamic Equations: E. W. WASHBURN.

Cuprous Hydroxide: W. D. BANCROFT.

Osmotic Studies: L. KAHLENBERG.

Crystallization through Membranes: J. H. WALTON.

An Explanation of the Negative Coefficient of Expansion of Silver Iodide: GRINNELL JONES.

The Significance of certain Numerical Relations in the Sugar Group: C. S. HUDSON.

The Formation of Nitric Oxide by the Action of Nernst Glowers on Air: IRVING LANGMUIR.

The Potential of the Sodium Electrode: G. N. LEWIS and C. A. KRAUS.

The Reaction Velocity of an Inorganic Hydrolysis: S. C. LIND.

The Solubility of Salts in Concentrated Acids: ARTHUR E. HILL and JOHN L. SIMMONS.

Transition from Metallic to Electrolytic Conduction: C. A. KRAUS.

A Dilution Law applicable to both Aqueous and Non-aqueous Solutions: C. A. KRAUS.

Equilibrium in Solutions containing Copper and Iodine: W. C. BRAY and G. M. J. MACKAY.

The Properties of Water near the Critical Point: R. C. MAILEY.

The Internal Heat of Vaporization: J. E. MILLS.

The Molecular Masses of Liquids: G. H. MEEKER.

Some Applications of the Phase Rule as a Means for Determining Water in Certain Organic Substances: S. W. PARR and F. W. BLISS.

Heat Conductance of Soils: H. E. PATTEN.

B. E. CURRY,
NEW HAMPSHIRE COLLEGE *Press Secretary*
Transmitted by C. H. HERTY,
Secretary of Section C

SOCIETIES AND ACADEMIES

THE TORREY BOTANICAL CLUB

THE meeting of December 8, 1908, was held at the American Museum of Natural History, President Rusby in the chair. About seventy-five persons were present. The announced scientific paper of the evening on "Mechanical Response of Plants" was then presented by Sir Jagadis Chunder Bose, professor in the Presidency College of Calcutta and author of "Response in the Living and Non-Living," "Plant Response as a Means of Physiological Investigation," etc. The presentation of the subject was accompanied by an exhibition of some of the ingenious and delicately contrived apparatus constructed by Professor Bose for the purpose of measuring and recording the responses of plants to various stimuli. Following is an abstract of the paper compiled from notes furnished by Professor Bose:

The effect of stimulus impinging on a responding tissue is to induce a fundamental molecular derangement. This condition of derangement constitutes excitation. On the cessation of stimulus, there is a slow recovery, the tissue returning to its original condition. This molecular reaction is itself beyond our scrutiny, but it may be shown that we can gauge its intensity and extent by the observation and record of certain concomitant changes induced by it in the responding tissue. Among these are (1) changes of form, manifested as mechanical response, and (2) changes of electrical condition, which may be recorded as electrical response.

The intensity of the responsive change will obviously depend on the two factors of strength of stimulus and physiological condition of the tissue. Hence, when stimulus is constant, the amplitude of response gives us a measure of the physiological condition. Now we know that the changing environment must induce unknown changes in this physiological condition, of which there is no outward sign. But we are here enabled to make the plant itself reveal its condition, by the reply it makes to the blow of a stimulus. A stimulating agent will exalt, and a depressing agent diminish or abolish, this response. We have thus a means of attacking the deeper problem of the physiological variation in an organism.

The speaker had been able to overcome the numerous difficulties which occur in connection with the automatic recording of the mechanical response of the plant, by devising three types of instrument. These are (1) the oscillating recorder, (2) the optical lever and (3) the balanced crescograph.

In the oscillating recorder, the recording lever is made of light aluminum wire and is suspended vertically on jewelled bearings. This lever is L-shaped, and the shorter arm, at right angles to the longer, is attached to the responding leaf. The great advantage conferred by the oscillating recorder lies in the fact that the friction of the writing point against the recording surface is practically eliminated. The source of friction in such arrangements arises from permanence of this contact. In this instrument, however, the writing lever is virtually free, except for the brief intervals in which the smoked glass surface is brought into periodic contact with it. For these records,

the glass surface moves in a vertical plane by means of clockwork, and a minute oscillation to and fro is given to it by the agency of an electromagnetic arrangement. The perio of this oscillation is, say, one fifth of a second, and the record is thus made to consist of a series of dots, separated by time-intervals of one fifth of a second. Thus we can see the time-relations of the curve at a glance.

For responsive movements of minute leaflets the speaker employed the optical lever. By use of this a very high magnification is possible. The record is made on a traveling photographic plate by the spot of light reflected from the optical lever, connected with the responding plant.

For the instant detection of the effect of stimulus on the rate of growth, the balanced crescograph is used. Here a balanced and stationary point of light undergoes a sudden movement up or down, according as the rate of growth is enhanced or depressed by the action of an external agent.

In order to study the effects of external agencies on physiological excitability, it is first necessary to obtain a series of normal responses under stimuli of uniform intensity and duration, applied at regular predetermined intervals. This is accomplished by means of the automatic stimulator, in which an expansible fan periodically closes the exciting circuit. The intervals between successive applications and the period of stimulation are, in this instrument, capable of adjustment at will.

In a complete curve of response of the sensitive leaf or leaflet of *Mimosa* or *Biophytum sensitivum*, we find (1) a short horizontal line representing the latent period, (2) an up-curve showing attainment of maximum reaction; followed by (3) a down-curve representing the recovery. The latent period in a vigorous *Mimosa* is about .24 second. The effect of fall of temperature or fatigue results in the prolongation of this latent period to .3 of a second in the former and .58 in the latter case. The maximum fall of the leaf was attained in 1.5 seconds. Complete recovery takes place in 6 minutes in summer and in 18 minutes in winter. In a leaflet of *Biophytum*, the maximum fall is attained in .5 of a second and full recovery is reached in 3 minutes. The excitatory fall of the leaf takes place when stimulus is applied at or near the responding point. Seen from different points of view, this reaction will appear as a diminution of turgor in the pulvinus, constituting a negative turgidity-variation, or a shortening or contraction of the more excitable lower half of the pulvinus. Electrically speaking, this reaction will have its concomitant in an electrical variation of galvanometric negativity. It is convenient to include all these excitatory symptoms together under the single term *negative response*. Here, however, we may describe a responsive change of precisely opposite character, which takes place under definite conditions. This *positive response* consists of an erectile movement of the leaf; a positive turgidity-variation, expansion, and an electrical change of galvanometric positivity. The occurrence of this positive response may be demonstrated, in *Mimosa*, by applying stimulus at a point distant from the responding organ. In a certain experiment, this positive or erectile response occurred .6 second after the application of a stimulus, and was followed, 2.8 seconds later, by the normal excitatory fall of the leaf. Here we have a response which is *diphasic*, positive followed by negative. When stimulus is moderate, and applied at a still greater distance, the response evoked is positive alone. These facts obtain universally, and from them we derive the following law of direct and indirect stimulation: *The effect at the responding-region of a strong stimulus transmitted to a short distance, or through a good conducting channel, is negative. The effect transmitted to a great distance, or through a semi-conducting channel, is positive.*

Responsive movements, like those of the "sensitive" plants so-called, can be detected also in ordinary plants. It will be noticed, in *Mimosa*, that the responsive movement is made possible by the unequal excitability of the upper and lower halves of the pulvinus, the movement being determined by the greater shortening or contraction of the lower. If now we take a hollow tubular organ of some ordinary plant, say the peduncle of daffodil, it is clear that the protected inner side of the tube must be the more excitable. When this is cut into the form of a spiral strip, and excited by means of an electrical shock, we observe a responsive movement to take place by *curling*, due to the greater contraction of the inside of the strip. This mechanical response is at its maximum at that season which is optimum for the plant. When the plant is killed, its response disappears.

In *Mimosa*, under continuous stimulation, there is a fatigue-reversal, the responsive fall being converted into a movement of erection. The same thing happens in the response of ordinary plants, when the first contractile movement of the spiral, for instance, is reversed, under continuous stimulation, to an expansive uncurling.

An important series of observations is that on the modification of response by the tonic condition

of the tissue. When the condition is sub-tonic, response is by the abnormal positive, instead of the normal negative, reaction. A strong or long-continued application of stimulus, however, converts this abnormal positive into normal negative.

Another important phenomenon is that for which the name of *multiple response* has been suggested. When the stimulus is very strong, the response is often not single, but repeated, or multiple. Excess of stimulus is thus seen to remain latent in the tissue, for rhythmic expression later. This storage of energy from the environment may in some cases be so great as to cause the continuance of rhythmic activity, even in the absence of immediate stimulation. We thus obtain a natural transition into so-called spontaneous or autonomous movements.

The various peculiarities of the spontaneous movements exhibited by *Desmodium gyrans*, or the telegraph plant, may be studied in the automatic record taken by the optical lever. The rhythmic tissues of the plant are then found to have characteristics which correspond to those of similar tissues in the animal. Lowering of temperature enhances the amplitude and diminishes the frequency of pulsation, in the rhythmic cardiac tissue of the animal. The same is found to be true of the pulsatory activity of *Desmodium gyrans*. The effects of various drugs are also very similar. The first result of the application of an anæsthetic like ether is to evoke a transient exaltation, followed by depression and arrest. Poisonous gases also induce a continuous depression of activity. A strong poisonous solution, again, induces a rapid arrest of pulsation.

It has thus been shown that by the waxing and waning of response, the variations in the plant's physiological activity, under changing external conditions, may be gauged. It has been shown also how numerous and varied are the factors that go to make up the complexity of plant-responses. It has been shown that stimulus may be modified in its effect, according as it is direct or indirect, and feeble, moderate or strong. The modifying influence of the tonic condition of the tissue has also been shown, according as this is normal, subtonic or fatigued. In the numberless permutations and combinations of these varied factors lies the infinite complexity of the responsive phenomena of life.

After a discussion of Professor Bose's paper by Doctors Rusby, Richards and Pond, the meeting of the club was adjourned to the second Tuesday in January.

MARSHALL A. HOWE,
Secretary pro tem.

THE ASSOCIATION OF OHIO TEACHERS OF MATHEMATICS AND SCIENCE

THE association held its annual meeting in the Chemical Laboratory of the Ohio State University, December 29 and 30, 1908. The attendance of all meetings was very gratifying. The following program was carried out:

TUESDAY, DECEMBER 29, 1908, 1:30 P.M.

General Session

Business.

Mathematics Section

"The Mathematical Club in the High School; its Use as a Supplement to the Work of the Recitation," by J. C. Boldt, department of mathematics, East High School, Dayton.

"On the Nature of Mathematical Knowledge," by F. E. Miller, professor of mathematics, Otterbein University.

Round table.

Science Section

"Physics as a Factor in Forming Character," by C. M. Brunson, department of physics, Central High School, Toledo.

"The Narrow Path or the Broad?" by H. E. Newman, department of chemistry, Walnut Hills High School, Cincinnati.

Round table.

WEDNESDAY, DECEMBER 30, 9:00 A.M.

General Session

Business.

"The Purification of Drinking Water," by C. W. Foulk, department of chemistry, Ohio State University.

Mathematics Section

"Should Mathematics be Taught as a Basal Science or a Tool of Science?" by Paul Bieford, professor of mathematics and astronomy, Buchtel College, Akron.

"Should the Seventh to Tenth Grades be a Unit in Mathematics?" by R. L. Short, department of mathematics, Technical High School, Cleveland.

Round table.

Science Section

"An Apparatus for Demonstrating Wave Motion," by Fred J. Hillig, professor of physics, St. John's College, Toledo.

Experiments and demonstrations.

Round table.

WEDNESDAY, DECEMBER 30, 1:30 P.M.

Excursion to filtration plant now operated by the city of Columbus.

RALPH W. BUCK,
Secretary

DAYTON, OHIO

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, FEBRUARY 26, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

NORTH AMERICA AND EUROPE: A GEOGRAPHICAL COMPARISON [1]

NOTHING could surpass my curiosity when I landed for the first time in North America, a new world, separated from the old one by a great ocean. As a geologist, I knew that similar rocks formed the land and that similar surface features would occur, but as a geographer, I knew too that the vegetation of North America differs from that of Europe and that there are only a few species common to both sides of the water. What will be the impression of the landscape—will it be European or a different type? But when I put my foot on the land near Quebec I became aware that the general features of the landscape and the surroundings of man were nearly the same there as in Europe, and only a closer inspection convinced me that I was amid a new flora. Indeed, I had the feeling of being not in a latitude south of Vienna, whence I had just come, but rather of being in the same surroundings as at Stockholm—twelve degrees of latitude farther north.

There are, indeed, very strong similarities between North America and Europe. A superficial glance at our maps will reveal similar features. Europe is only a peninsula of Asia, and the peninsular character determines all features of this continent. North America may be compared with the whole of Eurasia, and its eastern part shows a similar peninsular articulation as

[1] Inaugural lecture by the Kaiser Wilhelm Professor, delivered at Columbia University on November 3, 1908.

Europe. That peninsular region stretches east of the Mississippi Valley, the region of the Great Lakes and Hudson Bay, and there are doubtless more pronounced geographical differences between this articulated part and the continental part of North America than between peninsular North America and peninsular Eurasia—that is, Europe.

Europe gets its characteristic features from some invasions of the sea. Northeast of Scandinavia a part of the Arctic Sea penetrates into the land and branches here as the White Sea. Farther south the very edge of the continent seems to be inundated, so that Great Britain and Ireland are isolated, and from the German Sea the Baltic Sea extends far into the interior of the continent. Still farther south is the Mediterranean Sea, which separates Europe from Africa. All these features seem to be repeated on the west side of the Atlantic. Here we see the Arctic water penetrating far to the south, forming Hudson Bay. Farther south the eastern corner of North America is inundated; Newfoundland is isolated, like Great Britain; and the Gulf of St. Lawrence extends far into the interior of the country, getting its waters from that remarkable group of lakes which in many respects resemble the Baltic Sea. This resemblance was far stronger at the end of the last geological epoch, when a vast body of fresh water existed instead of the Baltic Sea which poured through the river valley of the Sund between Denmark and Sweden into the basin of the German Sea. The resemblance of the Gulf of Mexico to the Mediterranean is such a striking one that Alexander von Humboldt called it a mediterranean sea; and, indeed, it divides America into two separate continents—North America and South America.

These similarities between Europe and peninsular North America are not merely superficial ones. In a very remarkable way, these two sides of the Atlantic repeat the same structural features; there is an astonishing symmetry, as Eduard Suess has shown so clearly. The northeast of Canada and Labrador on one side, and Scandinavia with Finland, the region of Feno-Scandia, on the other, are both composed of the oldest rocks we know of. These have a very complicated structure, being intruded with many eruptive rocks, and in a secondary way only, the surface features of the above regions are dependent on their structure. Both regions had already been leveled down before Cambrian times, and they sink gently down under a cover of horizontal Paleozoic strata. Both were called by Suess shields. The resemblance between these shields is the more conspicuous because both were covered during the last ice age by a glaciation which molded their surface in a similar way. In Sweden and Finland we find the same rounded glaciated surface, the same numerous lakes, as in Canada, both regions of the earth claiming to be the land of the many thousand lakes. At the border of both regions the horizontal Paleozoic strata begin with an escarpment which is pronouncedly developed south of Lake Erie and south of the Gulf of Finland, called here the "glint," and we shall keep this expression to designate similar escarpments. These strata continue far into the interior of Eurasia, and they do the same in North America.

In the same way that we compare the Canadian Shield with the Scandinavian Shield we can compare the region east of the Mississippi Valley with the interior of Russia—both parts of the world have never been compressed by mountain-folding since Paleozoic time. Only a few faults occur here, and the whole geological history consists in slight up-and-down warps which brought both regions several times under the surface of the transgressing ocean. Also, here the younger geological history

has augmented the similarity. Huge morainic accumulations south of the Great Lake region of North America form the watershed between the Mississippi and St. Lawrence Rivers, and similar morainic deposits form the watershed between the Baltic and the Black Seas. Thick loess deposits are found in front of these morainic deposits in the Mississippi basin as well as in the interior of Russia. The loess gives rich harvests to the corn regions of Iowa, Nebraska, Kansas, Missouri and Illinois, the counterparts of which are found in Wolhynia and the region of the Tshernosiom of the south central governments of Russia.

East of the Mississippi basin the old Paleozoic strata are folded and form the Appalachian belt, and similarly, west of the plains of Russia the Paleozoic strata of Europe are folded, forming a set of mountains which we can trace from the south of Russia to the west coast of Europe. In the central part of Germany these mountains constitute the belt of the German upland, and here it was that their geological history was first understood. The folding of the strata occurred near the end of the Paleozoic era and ceased before the end of the Permian epoch. Then they were base-leveled and covered totally or in part by Mesozoic deposits, after which mountains arose by faulting and warping, forming here and there true tilted blocks. The elevated parts lost their Mesozoic covering and the folded old strata again became visible.

This history is nearly the same as that of the Appalachian region. Here also the folding of the strata ended towards the close of the Paleozoic era and the folded mountains were leveled down. Then they became partly or totally covered with Mesozoic deposits, and the mountains of to-day were formed by upheaval. In North America, indeed, they form a more connected zone, while in Europe they are mostly groups of mountains, separated from each other by basins of Mesozoic or younger strata. During the epoch of folding, the Appalachian region and the zone of the Hercynian Mountains of Europe may have formed mountains of the height of the Alps of to-day. I called them, therefore, the Paleozoic Alps of middle Germany, but to-day these regions have only lower altitudes; they do not surpass, as the Appalachian region does, 2,000 meters. The striking features of these base-leveled Paleozoic mountains consist of the fact that on both sides of the Atlantic the belt of their ancient foot-hills contains coal measures. As the Allegheny region in North America, so the mountains of South Wales, the northern boundary of the Ardennes and of the neighboring Rhenish mountains contain the richest coal measures. And as we find west of the Allegheny region some coal measures, so we find some extensive coal layers north of the belt of the Hercynian Mountains in England and Scotland, in upper Siberia, in the east of Germany, and in some places in the interior of Russia. The industrial evolution of eastern United States, of England and Wales, or Belgium and the German empire, is based on the same fact, that a rich vegetation once covered the foot-hill region of the mountains up-turned towards the end of the Paleozoic era.

It is very interesting to see how the Appalachian region ends at Newfoundland, forming the projecting eastern corner of North America, and just opposite in south Ireland, in South Wales, in Cornwall and in Brittany the belt of the old Hercynian Mountains of Europe begins. One seems to be the continuation of the other, and such an excellent geologist as Marcel Bertrand maintained that we have here to deal with the two ends of one very extensive belt of mountains which extended through

the North Atlantic Ocean. But we must not forget that the missing link between both ends of these supposed mountain chains is longer than their known extent.

There are also similar structural features between the Mediterranean Sea and the Gulf of Mexico and its surroundings. Both seas consist of a set of very deep basins, separated by higher regions which reach more or less above the sea-level, and the Mesozoic strata in their vicinity are folded, but there is one very marked geographical difference between their surroundings. On the north side of the Mediterranean Sea extends a nearly uninterrupted belt of mountains which contains the highest elevation of Europe, while there is no high mountain range at all at the north of the Gulf of Mexico. The high elevations on the north side of the Mediterranean sharply divide western Europe into an Atlantic and a Mediterranean part, while all the natural regions of eastern North America continue uninterrupted to the Gulf. The high mountain belt on the north side of the Mediterranean Sea prevents the rivers from entering the Mediterranean; it pushes aside the Danube and only the east annex of the Mediterranean—the Black Sea—receives in the Danube, the Dneiper and the Don, important rivers which can be compared with the branches of the Mississippi River. But the river of Europe which as to size and ramifications bears most resemblance to the Mississippi—the Volga—empties its waters into the Caspian Lake. This, the largest lake on the earth, can be regarded, however, as an isolated basin of the Mediterranean. During the Ice Age its waters stood probably so high that they could overflow through the Manytsh Valley, north of the Caucasus, into the Black Sea so that the Volga got an outlet into the open sea. Therefore, during the Ice Age the arrangement of the eastern European rivers corresponded more nearly with that of the Mississippi and its branches, and this similarity would even exist if we assume that then the Black Sea itself was an inland sea, for such an inland sea could pour its waters through the Bosporus into the Mediterranean. The Bosporus, indeed, bears many features of a river valley, and it may have been at one time the outlet of all European rivers from the Danube to the Volga, of a body of water as large as that of the Mississippi. But while the large American river enters the sea through a large delta deposited by it, the European Mississippi passed through narrows just above its mouth, as the Hudson does; it had to force its way through the mountain belt north of the Mediterranean.

The absence of such a mountain belt in North America causes an important difference in the climate of the peninsular regions on both sides of the Atlantic. The climate of Europe is hardly at all affected by the Mediterranean, whereas the absence of a mountain belt north of the Gulf of Mexico allows the winds to sweep around the west end of that zone of high atmospheric pressure which extends across the Atlantic. Thus we have southwestern winds in North America; and as the southwestern winds of Europe bring the moisture and the warmth of the Gulf Stream drifts over large areas of Europe, so also the moisture and warmth of the Gulf of Mexico is brought into the southeastern part of North America. The effect of the cooling influences which the interior of a continent can exert by its high pressure and cold on the mean latitudes of its east coast, is counteracted to a large extent, and peninsular North America enjoys as well, but not as much, as the European peninsula of Eurasia, a peninsular climate.

But the peninsular climate of both sides of the Atlantic is not the same. It is most strongly developed in peninsular North

America in the south, but in Europe, in the north. The southwest winds blow in peninsular North America mostly during the summer; in Europe, however, during the winter, just at the time when cold northwest winds bring cold waves to the United States, and similar temperature is met with in very different latitudes of both sides of the Atlantic. Indeed, the climate on both sides of an ocean can not be the same; there must be differences between the east and west shores of the continents. Europe has the true climate of the west coast of a continent. The climate of this side of the Atlantic has its exact counterpart in North America in British Columbia, and the Mediterranean climate reoccurs in all of its characteristic features farther south in California. The high elevations of the mountains of British Columbia and of the Sierra Nevada, however, hinder the extension of these climatic conditions into the interior of the continent, while the open west of Europe allows the western winds to carry their moisture very far into the interior, and the long extent of the Mediterranean Sea is accompanied by a climate like that of California from the south of Spain over the south of Italy and Greece as far as Asia Minor. Thus one very large climatic province of very uniform character extends between the Atlantic Ocean and those semi-arid regions in which the higher civilization of the Orient in ancient times was born. And this climatic province possesses many features similar to those of semi-arid regions. This fact is of the greatest importance for the evolution of civilization in Europe.

We can trace back the European population very far. Man witnessed in Europe that set of climatic changes which characterize the great ice age, but while it is still open to discussion whether the present population of Europe had its origin in that very old one or whether it came from Asia, there can be no doubt that the European civilization has its root in the Orient. Here in Mesopotamia and in Egypt an early civilization arose under arid and semi-arid conditions, based on irrigation; this civilization was brought by early navigators over the whole basin of the Mediterranean and it found congenial conditions everywhere along the shores. In America such an evolution was impossible. Indeed, an original civilization has grown up here under semi-arid conditions, and it was based, too, on irrigation. This is not surprising. Irrigation is the easiest way to introduce agriculture. It is only necessary to distribute water and crops become possible. There is not necessary the very difficult work of clearing the forests. But a certain political organization is necessary which begins at the moment when the rules are established according to which the water is distributed.

The conditions under which the early civilization on the plateau of Mexico was developed are, indeed, in many respects similar to those of the Orient. That civilization, however, was not only far more feeble than that of the Orient, but it could not extend in the same way. The American Mediterranean is far larger than that between Europe and Africa, and early navigation did not find here the same landmarks which allowed the Phœnicians and Greeks to sail so far, but above all the shores of that sea were not as inviting to settlers as those of Greece, Italy, Spain or northern Africa. They are covered for a wide extent by dense, tropical, nearly impenetrable forests, and a belt of those virgin forests hindered the Mexicans from extending their civilization down to the Gulf of Mexico. At no time has this sea played a rôle similar to the Mediterranean; a Roman empire could never grow up east of the cradle of the American civilization

along the shores of the sea between North and South America.

The Roman empire was a true Mediterranean state, but it pushed forward its frontiers as well to the deserts of the Orient as to the woodlands in the north. Woodlands only rarely favor the evolution of a primitive civilization. Agriculture needs here more than irrigation; the forests must be cleared. This is a very hard work which goes on very slowly, and it must be followed by a continual struggle against the constantly new-growing forests. Here the family work has the greatest success and political organization only will very likely be formed. Indeed, the Romans regarded the wood-folk in the north as barbarians, though these had a civilization of their own which was of not inconsiderable height. They had already submitted extensive ground to agriculture; they already manufactured iron, and they were settled in villages and towns. But there can be no doubt that the Romans brought them more of the high civilization of the Orient than had reached them through the commerce of the Phœnicians and Greeks. By this, the Romans aided their neighbors in the north until finally the latter left their forests and conquered the south.

This political movement had as a starting-point central Europe. This is the center around which the other parts of Europe are arranged in such a way that they can be directly reached, and while most of these other parts are more or less separated from one another, lying isolated like Great Britain, or stretching into neighboring seas like Scandinavia, or Spain, or Italy, or the Balkan peninsula, they all are either connected with or are near to central Europe. Therefore, the relations between those members of Europe and the center were always active. Open to all sides, this center has suffered by its neighbors when its population was feeble and without force; or, on the other hand, when its inhabitants are strong, they influenced all Europe. More than once central Europe acted as the heart of the European body and drove fresh blood into the members.

When the forest-folk of central Europe had gained from the Romans knowledge of the favored regions of the Mediterranean basin rich in all kinds of fruit, they began to move towards the south; they laid in ruins the Roman empire and founded new kingdoms, but they could keep their nationality only where they appeared in great numbers. They were absorbed by the peoples of southern Europe, and the German ground extended only in the southwest, along the Rhine, and in England. England still bears the name of the German tribe—the Angles—who, together with the Saxons, conquered that extreme part of the old Roman empire, and in the whole of Europe we find witnesses of former German immigration. In the south of Spain, the name of Andalusia reminds us of the German tribe of the Vandalians who came from the Baltic Sea. In upper Italy, Lombardy conserves the name of those long-bearded Germans who settled there, and in the regions north of Milan you see more blond people with blue eyes than in many parts of the German empire. France received her name from the German Franks who extended their empire there.

The emigration of the German wood-folk seems not to have been caused by the pressure of other peoples. There seems to have been awakened a yearning among the German tribes to occupy better countries than their own. It seems to have been a similar longing to migrate and to settle new countries as that which prevailed in the eastern states of North America for more than one hundred years and which caused that enormous extent of the Anglo-Saxon race over the whole continent of North America. As in New England, the woodlands which were

left by their agricultural population were settled by new emigrants—the old Puritan ground being entered by Roman Catholic Irish and Italians and French Canadians and Russian Jews—so also in Germany the areas were resettled which had been left by their emigrating inhabitants, especially the eastern part. But the emigration had been more complete than in eastern New England, and the new settlers found a vacant country in which they could introduce their own language. A reaction, however, set in, and since the times of Charlemagne the Germans have been taking back their old land from a population whose descendants are to-day, in North America, classed as undesirable immigrants.

While this was beginning, the northern neighbors of the Germans, the Scandinavians, were seized with a similar longing to migrate that the Germans had experienced several hundred years ago, but while the Germans migrated on the land, the Scandinavians went on the sea. Scandinavian tribes crossed the Baltic Sea and crossed into the forests of northern Russia, where they founded the Russian empire, the name of which points back to the times when the Scandinavian conquerors used their slavish subjects as "rowsmen." Scandinavian pirates devastated the coast of northern Germany, of England, Scotland and France, where they settled, forming Normandy. They sailed into the Mediterranean Sea and at Constantinople met with countrymen going through Russia. Others went into the northern seas, discovering the Fäer Oer, Iceland and Greenland. They even came over to North America, but this discovery was accompanied by a large number of men prepared to settle, and it remained unknown to the greater part of Europe. Even Greenland was totally forgotten, and its few Scandinavian inhabitants expired when they came into contact with the Eskimo population. Thus the outburst of Scandinavian peoples, like the older outbursts of German peoples, resulted in but a slight expansion of Scandinavian ground. The Norman settlers along the Mediterranean and the shores of the Channel became intermixed with their neighbors, and when the Normans conquered England they brought with them French language and French customs.

In Germany, after the time of martial expansion of the people was over, more settled conditions ensued, and the vast forest-clad mountain regions which had heretofore been only visited by hunters were now cleared and a kind of interior colonization took place in the central part of the empire. The terminations "reute" and "schwende" of names of German villages indicate that the clearing of their forests was either by felling or burning the tree, and so famous became the Germans as clearers of woodland that they were called into the mountains of Bohemia, Silesia and Hungary, where peaceful colonization took place. German colonies, following the extension of German sea traffic, were founded along the shores of the Baltic Sea and even on the west coast of Norway, where the city of Bergen is a German colony; even centuries after, when the Russian empire had been extended from the Baltic to the Black Sea and to the Pacific, Germans were invited to settle in order to cultivate the country. These German colonies, which spread over all Russia, are found even in the steppe countries east of the Volga and of the Crimea.

Those waves of Asiatic steppe roughriders which now and then spread out over the low ground of eastern Europe, were always broken when they reached German ground. Here the Hungarians were defeated. The Mongolian wave which had terminated the early Russian empire met with the same fate when it came to eastern Germany, as did the wave of Turks which

so easily rushed over Hungary. From the walls of Vienna imperial German armies drove back the Turks into those frontiers of Turkey, which lasted until the end of the nineteenth century, and German settlers founded a new culture in Hungary.

Thus the influence of early German conquest and later German peaceful colonization is felt nearly over the whole of Europe. The earlier conquest formed the nobility of France and Italy, where many noble families still conserve more or less corrupt German family names, and German names were long in use for noblemen in medieval times. German colonists developed the agricultural resources of the southeast and east of Europe and German merchants extended their commerce on the coast of the whole Atlantic Europe.

This kind of peaceful German extension is also favored by the central position of Germany in Europe, but it is very much based on the fact that Germany herself is not a country too much favored by nature, and it is her very poor soil which has educated her population to strong and intelligent labor. This population, however, increased to greater numbers than the ground could support, and this is the real cause of the expansion of German population by immigration, the influence of which has been so markedly felt by all Europe. It is the natural expansion of a strong, working forest-folk and one which resembles very much the expansion of the people on the east coast of North America over a whole continent.

The virgin forests of peninsular North America were far out of the reach of original American civilization, which could neither spread out over the shores of the American Mediterranean nor cross the arid regions and deserts north of Mexico. Their Indian inhabitants remained in the state of hunters and never cleared the woodland. The natural riches of that region were developed only when it was settled by Europeans, who had learned in Europe to overcome the resistance of forests to agriculture. And soon after its colonization, its population experienced that strong wish to expand which is so characteristic of early German migrations. The descendants of that population on the Atlantic slope of North America, who had cleared the virgin forests, crossed the Appalachian chain, cultivated the prairie grounds of the Mississippi basin, and adapted themselves to the arid climate of the west and the Italian climate of California. Thus the Atlantic side of North America plays in its colonization a rôle similar to that of Germany in the history of Europe.

The expansion of eastern North Americans, however, met with no strong resistance from the other inhabitants of North America. The Indians defended their ground in insufficient numbers and with insufficient arms, and they died out when they came into contact with higher civilization. In Europe, on the other hand, German emigrants spread amid peoples of larger numbers, and became, therefore, partly absorbed. The difference in expansion between the Atlantic North American and the German populations is neither caused by a greater strength of the North American expansion, nor by a lower education of German settlers; it is due to the fact that the North American expansion extended over a continent inhabited only by nomadic tribes of small numbers and of low civilization, while the German expansion extended over vast areas occupied by peoples with a culture and an organization of their own. This again is due to the fact that higher civilization spread out over all Europe, while the native civilization of North America remained restricted to the plateaus west of the Gulf of Mexico.

There is a remarkable resemblance between the expansion of German population

and that of America, and if we follow the latter to its sources we find that the early English settlers on the east coast are the descendants of German conquerors of England and their extension towards the west was followed and reinforced by a powerful wave of peaceful German immigrants, differing in language but similar in kind, and both waves formed one population in which the old German spirit of expansion is very active.

It is a curious chance that America received its name from a German geographer. Old Professor Waldseemueller made a mistake, indeed, when he named the new countries at Brazil after the Florentine Amerigo Vespucci. It would have been far more just to name the new world after Columbus, but though Waldseemueller recognized his mistake and withdrew the name, it remained in use. And curiously enough, that Amerigo Vespucci whose name gave origin to the name of America, had himself, though an Italian, still a German family name, Emmerich, Emery in English. Thus America is a continent with a German name, the meaning of which might, perhaps, be interpreted as "rich in corn";[2] if this is correct, Professor Waldseemueller chose an incorrect but appropriate name.

There are many connecting links between North America and Germany, but the strongest of these links is mutual friendship. True friendship needs no long words. I say to my friend, "Come, enter my house and feel at home"; and so I invite you to enter my home with me and to listen to my lectures on Germany.

ALBRECHT F. K. PENCK

REPORT OF THE COMMISSION ON AGRICULTURAL RESEARCH

THE Commission appointed by the Association of American Agricultural Colleges and Experiment Stations in 1906, to consider the organization and policy that should prevail in the expenditure of public funds for agricultural research, and kindred matters, has presented its report.

The members of the commission, David Starr Jordan, Stanford University, California, chairman; Whitman Howard Jordan, of Geneva, New York, secretary; Henry Prentiss Armsby, State College, Pennsylvania; Gifford Pinchot, Washington, D. C., and Carroll Davidson Wright, Clark College, Worcester, Massachusetts, agree in signing the report except that Mr. Pinchot makes some reservations. They summarize their recommendations as follows:

1. Every effort should be made to promote the training of competent investigators in agriculture both in the agricultural, and, so far as practicable, in the non-agricultural, colleges and universities, and their training should be as broad and severe as for any other field of research.

2. The progress of agricultural knowledge now demands that agricultural research agencies shall deal as largely as possible with fundamental problems, confining attention to such as can be adequately studied with the means available.

3. The work of research in agriculture should be differentiated as fully as practicable, both in the form of organization and in the relations of the individual investigator, from executive work, routine teaching, promotion and propaganda, and should be under the immediate direction of an executive trained in the methods of science who should not be hampered by other duties of an entirely unlike character.

4. The investigator should be free from all coercion whatever. In reaching his conclusions he should be equally free from the prescription of received opinion and the temptation to exploit his results for the purpose of obtaining future support. To this end, his work should be as far removed from immediate dependence upon legislation as is consistent with due responsibility to the public, and his relations to the public and to the organization of which he is a member should be such as to promote individual initiative and not interfere with freedom of conclusion or utterance on scientific questions.

5. There should be a clearer definition of the relative fields of work of the United States Department of Agriculture and the experiment stations. The dominance of the stations within their

[2] Amar, old German, a kind of wheat.

respective fields should be preserved and their growth fostered, as agencies for the investigation of local questions and of the more individual scientific problems. The federal agency, on the other hand, should cultivate the almost limitless field offered by questions having national or interstate relations and by those broad scientific problems requiring heavy expenditures, elaborate equipment, long continued study and the correlation of the results of many investigators, which efforts are usually beyond the means of an individual station. On many questions the harmonious cooperation of the two agencies is essential to the highest efficiency of effort.

6. Any research agency charged with a single main line of investigation should be so organized that it may employ within itself all necessary processes in any branch of science. The cooperation of any or all the departmnets of an experiment station on a single problem, when necessary, should be a fundamental requirement.

7. Research work, both national and state, should be provided for by separate, lump-sum appropriations, to be distributed according to the discretion of the responsible executive head of each agency.

8. Investigation into the business, economic, social and governmental conditions affecting agriculture should be undertaken and should be maintained on a permanent and effective basis.

9. An advisory board is suggested consisting of members appointed by the Secretary of Agriculture and by the Association of American Agricultural Colleges and Experiment Stations, respectively, which shall confer with the Secretary of Agriculture regarding the mutual interests of the department and the stations and shall consider the promotion of agricultural investigation in general.

THE RHODES SCHOLARSHIPS

THE number of scholars in residence at Oxford under the Rhodes bequest during the academic year 1907–8 was 156. Sixty-six were from colonies of the empire, 11 from Germany and 79 from the United States of America. In addition to these, 11 men whose scholarship term had expired continued to reside in the university for a whole or part of the year; 1 as an official fellow, 2 as lecturers, 1 as a Senior Demy of Magdalen and 6 for further study in various subjects. At the end of the summer term 54 scholars completed their course at the university and took their examinations. At the beginning of the October term 1908 there was an entry of 78 new scholars, while 3 other scholars (colonial) who had temporary leave of absence returned to complete their course. The whole number of scholars in residence for the academic year 1908–9 is therefore 178. These are distributed as follows among the colleges: 15 at Balliol, 14 at Christ Church, 13 each at Exeter and Queens, 12 at St. John's, 11 each at Hertford, New College and Worcester, 10 each at Merton and Wadham, 9 at Oriel, 8 each at Lincoln and Pembroke, 7 each at Brasenose, Trinity and University, 6 at Magdalen, 4 at Jesus and 2 at Corpus. There are, in addition, 11 ex-scholars in residence for the October term, engaged either in teaching, research or special study for examination. The total so reached of 189 is the highest point in numbers hitherto attained. The work of the scholars now in residence is distributed as follows over the different courses of study organized in the university: Literæ Humaniores, 20; natural science (geology, chemistry, physiology and physics), 18; jurisprudence, 38; history, 20; mathematics, 4; theology, 9; English literature, 7; oriental languages, 1; modern languages, 4; Honor Moderations—classical, 3.

THE DARWIN CENTENARY

IN addition to the exercises in New York, Philadelphia, Chicago and elsewhere in honor of the hundredth anniversary of Darwin's birth, which have already been noted in SCIENCE, memorial exercises were arranged by several other institutions.

At Cornell University the event was commemorated by two lectures by Professor J. H. Comstock on "The Basis of the Theory of Evolution," a lecture on "The Relation of Darwinism to the Modern Theories of Evolution," by Professor Herbert J. Weber, and an address by President Schurman on "Darwinism and Modern Thought."

AT a special meeting of the Scientific Association of the University of Missouri, held on February 12, in commemoration of the

one hundredth anniversary of Darwin's birth and the fiftieth anniversary of the publication of the "Origin of Species," the following addresses were delivered: "Biographical Sketch of Darwin," by Professor W. C. Curtis; "Darwin's Contribution to Evolution," by Professor C. Stuart Gager; "Pre-Darwinian Evolution," by Professor A. O. Lovejoy; "Post-Darwinian Evolution," by Professor George Lefevre; "The Influence of Darwin's Work on Ethics," by President A. Ross Hill; "The Influence of Darwin's Work on Sociology," by Professor C. A. Ellwood; "The Influence of Darwin's Work on Psychology," by Professor Max Meyer; "The Influence of Darwin's Work on Theology," by Rev. Dr. W. W. Elwang. Mr. F. A. Sampson, secretary of the State Historical Society of Missouri, read a most interesting series of letters written by Darwin about 1878 to Mr. R. A. Blair, of Sedalia, Missouri, concerning what was at first supposed to be a case of the inheritance of a mutilation in a flock of geese.

ON Thursday evening, February 11, Dr. J. M. Reade, of the University of Georgia, delivered a lecture on "Charles Darwin," before the University Club. Commemoration exercises were held at the home of Professor H. C. White, of the University of Georgia, on Friday, Feb. 12, in honor of Darwin. The program consisted of: "Biographical Sketch," by Dr. H. C. White; "Organic Evolution," by Dr. J. P. Campbell; "Evolution in History," by Dr. J. H. T. McPherson; "The Church and Evolution," by Rev. Troy Beatty.

A SPECIAL meeting of the Boston Society of Natural History was held on the evening of February 12, in commemoration of the centenary of Charles Darwin's birth and of the fiftieth anniversary of the publication of his "Origin of Species." After introductory remarks by Vice-president R. T. Jackson, the following brief addresses were made: By Professor W. H. Niles on the "Early Life of Darwin and his Contributions to Geology"; by Professor E. S. Morse on "The Factors of Darwinism"; by Professor G. H. Parker on "A Mechanism for Correlated Characters," and by Professor W. M. Wheeler on "Pre-Darwinian and Post-Darwinian Biology."

AT the general meeting of the American Philosophical Society on the evening of Friday, April 23, a Darwin celebration will be held. Charles Darwin and his grandfather, Erasmus Darwin, were members of the society, and his son, Sir George Darwin, is at present a member. On this occasion there will be three special addresses by members of the society: The first by the Right Hon. James Bryce, the British ambassador, who will give some personal reminiscences of Darwin and of the impression made by the appearance of the "Origin of Species" in 1859; the second by Professor Goodale, of Harvard University, on "The Influence of Darwin on the Natural Sciences," and the third by Professor James Mark Baldwin, of Johns Hopkins University, on "The Influence of Darwin on the Mental and Moral Sciences."

SCIENTIFIC NOTES AND NEWS

PROFESSOR CHARLES B. RICHARDS, professor of mechanical engineering at Yale University since 1884, and Dr. W. G. Sumner, professor of political and social science since 1872, will retire from active service at the close of the present academic year.

THE Rumford Committee of the American Academy of Arts and Sciences has recently made the following grants: To Director W. W. Campbell, of the Lick Observatory, \$250, for the purchase of a Hartmann photometer; to Professor R. W. Wood, of the Johns Hopkins University, \$150, in aid of his research on the optical properties of mercury vapor.

MR. O. J. R. HOWARTH has been appointed assistant secretary of the British Association in succession to Mr. A. Silva White.

SIR DANIEL MORRIS, K.C.M.G., late British commissioner of agriculture for the West Indies, has been selected for the newly-created office of scientific adviser to the secretary of state for the colonies on matters relating to tropical agriculture.

DR. R. PILGER has been appointed custodian of the Botanical Garden in Dahlem, Berlin.

THE committee of the Athenæum Club has elected, under the provisions which empowers the annual election by the committee of nine

persons "of distinguished eminence in science, literature, the arts, or for public services," Mr. Horace T. Brown, F.R.S., LL.D., and Sir David Bruce, F.R.S.

Sir William White was the guest of the Sheffield Society of Engineers and Metallurgists at their biennial dinner on February 26.

Dr. F. A. Dixey has been elected president of the Entomological Society of London.

Professor Ramón y Cajal, of Madrid, and Professor Emil Fischer, of Berlin, have been elected honorary members of the Paris Biological Society.

A Swiss Neurological Society has been formed, the headquarters of which are at Zürich and the first president of which is Professor von Monakow.

We learn from *Nature* that Dr. F. H. Hatch has been appointed by the government of Natal to make an examination of the mineral resources of the colony, and will shortly proceed to South Africa for that purpose.

Dr. Sven Hedin lectured before the Royal Geographical Society on February 7, and proposed to give a number of lectures in England in the course of the following month on "My Recent Expedition in Tibet."

Convocation Day was observed by the University of Pittsburgh on February 12, Lincoln's birthday. An address was made by Colonel Samuel Harden Church upon Lincoln, by Dr. W. J. Holland upon Darwin, and by Dr. J. A. Holmes, of the United States Geological Survey, upon "The Conservation of Our National Resources." Vice-president-elect James S. Sherman was present and made a brief address. The honorary degree of LL.D. was conferred upon Hon. James S. Sherman, Colonel S. H. Church and Judge William Waugh, of Greenville, Ohio, who graduated from the university seventy years ago in the class of 1839. The degree of Sc.D. was conferred upon Mr. F. A. Lucas, curator-in-chief of the Brooklyn Institute of Arts and Sciences, Dr. J. A. Holmes, of the United States Geological Survey, and Mr. Edward Goodrich Acheson, the electrical engineer.

A sum of over $10,000 has been subscribed to a monument to be erected in honor of Berthelot, the eminent chemist.

Dr. Carroll D. Wright, the first president of Clark College, U. S. Commissioner of Labor from 1885 to 1905, president of the American Association for the Advancement of Science in 1904, eminent for his contributions to statistics and sociology, died at Worcester, Mass., on February 20, at the age of sixty-eight years.

Dr. Ernest S. Wheeler, lecturer on tropical medicine in the Dartmouth College Medical School, died on February 15, at the age of forty years.

At the suggestion of the North American Conference on the Conservation of Natural Resources, in session in Washington last week, President Roosevelt has determined to issue, through the state department, invitations to all nations to send delegates to an international conference on conservation, to be held at The Hague.

Mr. Andrew Carnegie has given $100,000 for branch buildings to the Cincinnati public library.

Dr. George Gore, F.R.S., formerly lecturer on chemical and physical science at King Edward's School, Birmingham, who died on December 20, aged eighty-two years, left an estate valued at £6,802. The testator left £500 in personal bequests and £100 to the Birmingham University. All his other property he left equally between the Royal Society and the Royal Institution of Great Britain.

The Gordon Wigan income for 1908 at the disposal of the Special Board of Biology and Geology, of Cambridge University, has been applied as follows: (*a*) £50 to D. Sharp, M.A., the curator in zoology; (*b*) £50 to A. G. Tansley, M.A., to enable the Botanic Garden Syndicate to continue to offer special facilities for plant-breeding experiments; (*c*) £50 to Professor Hughes, being £30 for the purchase of a projection lantern for the geological department and £20 for the expenses of research on Pleistocene deposits in the neighborhood. The prize of £50 from the fund for

an investigation in chemistry was awarded to Leonard Angelo Levy, B.A., Clare, for his essay entitled "Investigations on the fluorescence of Platinocyanides." Grants out of the balance on income account amounting to £180 were made to the departments of physics, mineralogy and engineering, to defray the cost of special apparatus.

By arrangement with the Bermuda Natural History Society, the Station for Research at Agar's Island will be open for about seven weeks this summer. There are accommodations for a limited number of instructors or research students in either zoology or botany. Members of the expedition will sail from New York on one of the steamers of the Quebec Steamship Company's Line (probably the *Bermudian*) about the middle of June, or, for those who can not sail so early, about the first of July. Further information may be obtained from Professor E. L. Mark, 109 Irving Street, Cambridge, Mass.

A plan of cooperation between the United States Bureau of Plant Industry and the department of pharmacy of the University of Wisconsin has been adopted, the purpose of which is to provide for the cultivation of medicinal plants. Investigation and research work is to be carried on in connection with the growing of those plants used in the preparation of drugs and medicines.

A tuberculosis exhibit consisting of the Wisconsin exhibition at the International Tuberculosis Congress, together with reproductions of the best features of all the other exhibits at that congress, has been prepared by the department of bacteriology of the University of Wisconsin and the Wisconsin Anti-Tuberculosis Association, and is to be sent out to cities throughout the state by the university extension division of the state university. The exhibit shows in graphic and striking forms the great losses resulting from the ravages of tuberculosis, the best preventive measures and the most effective and economical means of cure. An experienced demonstrator will be in charge of the exhibit to explain the various charts, doors of houses, sleeping bags, window tents, photographs, etc.

Dr. J. O. Wakelin Barrett and Dr. Warrington Yorke, members of the Blackwater fever expedition of the Liverpool School of Tropical Medicine, who went out to Nyasaland in August, 1907, have returned. The London *Times* states that the expedition was well provided and equipped for pathological and chemical research, and during their fourteen months' operations the investigators had unusual opportunities for studying the fever. According to their report, nearly all the cases occurring in the protectorate came under their observation. Every assistance was afforded the expedition by the government medical staff and the Shire Highlands Railway Company, the latter granting special facilities for the use of the line, which was a matter of great importance, seeing that the majority of attacks of blackwater fever occurred in the vicinity of the railway. The fever, however, is usually most prevalent during the rainy season, when means of communication are more or less interrupted, and movement from place to place is difficult. Hence the members of the expedition sometimes had to travel in extremely heavy rain, but even that was found preferable to the intense heat of the midday sun by the river. The expedition, the cost of which was met equally by the Colonial Office and the Liverpool School of Tropical Medicine, was from time to time in touch with the expedition sent out by the school nearly two years ago for the study of sleeping sickness in northeast Rhodesia and the south of Lake Tangányika. The school has also a yellow fever expedition in Brazil and a malaria expedition in Jamaica.

The Belgian Permanent Committee on Human Alimentation, which was founded on the occasion of the International Congress on Food held at Ghent in 1908, held, as we learn from the *British Medical Journal*, its first meeting at Brussels on December 23, 1908, under the presidency of Dr. A. J. J. Vandervelde, of Ghent. Among the objects aimed at by the committee are the organization in Belgium of congresses on food, and the par-

ticipation of that country in international congresses on the same subject, the study of questions relating to the prevention of fraud, the supervision of the sale and manufacture of food preparations, and the promotion of uniform international methods of analysis. The committee will also investigate the question of human food from the chemical, physiological, technical, commercial, legislative, economic and social points of view. The committee consists of fifty members representing the scientific as well as the industrial and commercial worlds. There are three vice-presidents: MM. Libotte, of Antwerp; Sohier, of Liége, and Professor van Laer, of Brussels. Dr. Schoofs, of Liége, is general secretary.

A FRIEND of the *Scientific American,* who desires to remain unknown, has paid into the hands of the publishers the sum of $500, which is to be awarded as a prize for the best popular explanation of the Fourth Dimension, the object being to set forth in an essay the meaning of the term so that the ordinary lay reader can understand it. No essay must be longer than 2,500 words. Each essay must be typewritten, bearing only the pseudonym. With the essay should be sent a second plain sealed envelope, also labeled with the pseudonym and be sent to "Fourth Dimension Editor, *Scientific American,* 361 Broadway, New York, N. Y.," by April 1, 1909. Professor Henry B. Manning, of Brown University, and Professor S. A. Mitchell, of Columbia University, will be the judges.

ACCORDING to a special press bulletin prepared by Waldemar Lindgren, of the U. S. Geological Survey, the gold-mining industry of the United States had a prosperous year in 1908, in spite of adverse conditions of trade and finance. The director of the mint estimates the production of gold for 1908 from domestic sources at $96,313,256, against $90,435,700 in 1907. South Dakota, Alaska, California and Colorado show large estimated increases, ranging from $2,000,000 to $3,600,000. The estimates for Utah indicate a decrease of about $1,200,000; for Nevada a decrease of $3,300,000. The production of Montana, Arizona, Idaho, Oregon and other silver-producing states has remained approximately stationary. The production from the Philippine Islands shows an increase, the estimate of the mint being $306,708, against $78,700 in 1907. As part of the Philippine gold does not reach the United States mints the showing is probably even better than these figures would indicate. Most of the gold was recovered by quartz mining in Benguet and by dredging operations in Paracale. The silver-mining industry presents a far less satisfactory condition than that of gold, owing to the low prices for silver, lead, copper and zinc. During the year the large smelters of Utah and Colorado were partly closed and partly operated on a reduced capacity.

THE following lectures will be delivered at Columbia University on The Henry Bergh Foundation for the Promotion of Humane Education, 1908–9, Wednesdays at 4.10 P.M., in Room 309 Havemeyer Hall:

February 3—"The Influence of Humane Ideals and Practises in Human Civilization," by Franklin Henry Giddings, Ph.D., LL.D., professor of sociology and the history of civilization, Columbia University.

February 10—"Pure Food as an Element in the Humane Treatment of Men and Animals," by H. H. Wiley, Ph.D., of the Department of Agriculture, Washington, D. C.

February 17—"The Humane Treatment of Animals," by Albert Leffingwell, M.D., of Aurora, N. Y.

February 24—"Science and Animal Experimentation," by Nathan Oppenheim, M.D., of New York.

March 10—"Hunting with the Camera," by George Shiras, 3d, of Washington, D. C.

March 17—"The Humane Treatment of Children," by Homer Folks, secretary of the New York State Charities Aid Association.

March 24—"The Humane Treatment of Criminals," by Samuel J. Barrows, D.D., president of the International Prison Commission.

March 31—"The Ethics of Punishment," by John Dewey, Ph.D., LL.D., professor of philosophy in Columbia University.

April 7—"The Economic Aspect of the Humane Treatment of Children and Animals," by Roswell C. McCrea, Ph.D., of the New York School of Philanthropy.

Professors Morton Prince and George V. N. Dearborn, at the Tufts College Medical School, Boston, offer a course on psychopathology, required for fourth-year students of medicine. The course, which is said to be the first of the kind, will cover the following topics:

Mental physiology.—Mechanism of memory, including physiological (unconscious) memories (spinal cord and ganglia). Meaning of the unconscious. Formation and conservation of unconscious complexes. Meaning of the subconscious and co-conscious. Integrative action of the nervous system. Habit-formation. Emotion. Influence of psychical processes on the functions of the viscera (digestive, vasomotor, secretory, respiratory systems, etc.). Cenesthesia. Hypnosis (theory and phenomena). Suggestion. Idea-complexes.

Dissociations of the mind.—Anesthesia. Paralysis. Amnesia. Abstraction. Hypnoidal states. Sleep. Trance states. Fatigue. Subconscious ideas and their activity. Unconscious processes. Abulia.

Syntheses.—Sensory automatisms (visual and auditory hallucinations). Paresthesiæ. Pain. Motor automatisms (spasms, contractures). Recurrent mental states. Obsessions. Impulsions. Fixed ideas. Delusions. Unconscious mental complexes and their influences. Dreams.

Special pathology.—Neurasthenia. Hysteria. Psychasthenia. Hypochondriasis. Phobias. Habit psychoses and neuroses. Mimicry. Psycholeptic attacks. Recurrent sensorimotor attacks. Amnesic states. Dissociated personality. Fugues. Tics.

Methods of examinations besides the ordinary clinical methods.—Psycho-analysis. Abstraction. Hypnoidization. Hypnosis. Automatic writing. Artificial hallucinations. Psychogalvanic tests. Word reaction tests.

Principles of psychotherapeutics based on psychopathology.

UNIVERSITY AND EDUCATIONAL NEWS

The University of Virginia has completed an endowment fund of \$1,000,000 of which half has been given by Mr. Andrew Carnegie.

The educational commission which has for the past two years been codifying and revising the school laws of Pennsylvania, has created Colleges of Education at the Universities of Pennsylvania and Pittsburgh. These colleges will have as their specific functions the training of high school and normal school teachers, principals and superintendents of schools, supervisors of the various school grades, supervisors of special branches, and experts for service in the public school system of the Commonwealth. The code provides that the state shall pay the tuition of Pennsylvanians who are normal school graduates or who have successfully completed the sophomore year of a college. While no state aid is asked at the present session, it is provided that the legislature may make special appropriations for buildings, equipment and other needs of the Colleges of Education as from time to time may be deemed necessary.

In accordance with the principles of university nomenclature adopted by the Association of American Universities, the University of Wisconsin has changed the title of the college of law to that of "Law School," and the name of the college of medicine was changed to that of "Medical School"; the recommendation of the Association of Universities being that the term "school" be applied to those professional departments requiring for admission at least two years of college work.

On February 15 the University of Nebraska celebrated the fortieth anniversary of the granting of the charter under which the institution was organized. The address was given by Dr. Ellery W. Davis, dean of the College of Literature, Science and the Arts, on "A Coming Aristocracy."

The scheme prepared by the charity commission under the will of the late Mr. John Innes, of Merton, has now been settled. The most important part relates to the institution of a national horticultural college at Merton.

The Italian minister of education, Signor Rava, has pledged himself to the restoration in its integrity of the University of Messina, promising the students that it shall not be transferred elsewhere. Attention has been called to the fact that in view of the 16 other state universities, of which two are in Sicily—at Palermo and Catania—this concession to passing sentiment is to be deplored as only adding needlessly to the complications of the revival of Messina.

DR. JAMES BURRELL ANGELL submitted his resignation of the presidency of the University of Michigan on February 17, to take effect at the close of the academic year, and the board of regents created the office of chancellor and offered it to him at a salary of $4,000 a year with the continued use of the president's house. Dr. Angell, who on January 7 last celebrated his eightieth birthday, has been head of the university since 1871, when he came from the presidency of the University of Vermont.

THE methods by which even our best daily papers are edited are illustrated by the fact that the New York *Sun*, on February 18, contained an article, the headlines of which announced that the presidency of the University of Michigan had been offered to Professor Jenks, of Cornell University, whereas in the article itself it was stated that no selection had been made. The New York *Times*, of February 20, contained an editorial article congratulating Professor Finley on his call to the presidency of the University of Michigan, and expressing hope that he would not go, especially on account of his admirable after-dinner speeches, whereas the news columns contained the statement that President Finley had denied that such a call had been made.

IT is announced that Miss Agnes Irwin will resign the deanship of Radcliffe College at the close of the present academic year.

AT Yale University, Professor L. P. Breckenridge, of the University of Illinois, has been appointed professor of mechanical engineering and Dr. W. R. Coe has been promoted to a full professorship of biology.

THE council of New York University announces the appointment of J. Edmund Woodman as professor of geology and director of the geological museum, to fill the vacancy caused by the retirement of Professor John J. Stevenson; and of Holmes Condict Jackson to be professor of physiology and director of the laboratory of physiology in the University and Bellevue Hospital Medical College, to fill the vacancy caused by the resignation of Professor Graham Lusk. Professor Woodman received the degree of doctor of science from Harvard in 1904 and is now professor of geology at Dalhousie University, Halifax, Canada. Professor Jackson received the degree of doctor of philosophy from Yale University in 1899, and was instructor in physiological chemistry in the Sheffield Scientific School for three years. After study abroad he received an appointment as instructor in physiological chemistry in New York University, and became assistant professor in 1903. In 1905 he resigned to accept a position as adjunct professor in experimental physiology and physiological chemistry and director of the laboratories in the Albany Medical College, which position he now holds.

R. H. WHITBECK, of Adelphi College, Trenton, N. J., has been appointed associate professor of geography and physiography at the University of Wisconsin, beginning with the next academic year.

SIR T. H. HOLLAND, F.R.S., director of the Geological Survey of India, has accepted the offer of the chair of geology at Manchester University vacated by Professor Boyd Dawkins, F.R.S. Dr. W. H. Lang has been appointed Barker professor in cryptogamic botany and Dr. Marie C. Stopes special lecturer in palæobotany.

DISCUSSION AND CORRESPONDENCE

APPOINTMENTS IN COLLEGES AND UNIVERSITIES

TO THE EDITOR OF SCIENCE: It has for several years been a question of absorbing interest to me whether our American methods of making university appointments might not be much improved, especially in view of the fact that much better methods are in operation in other countries. It was a pleasant surprise to me to notice that others were agitating the same question, as is made evident by the discussion begun by Professor Wenley and continued by Professor Miller in SCIENCE of August 21 and October 23, respectively. It seemed to me that the time was ripe for some action on this matter. I therefore seized the opportunity of presenting my views

to my colleagues of the Chicago Section of the American Mathematical Society, assembled in an informal way at a dinner on January 1, in connection with the regular meeting of that body. I enclose a copy of the remarks which I made upon that occasion. Let me supplement these remarks with the statement that a committee of the Chicago Section has been appointed to investigate the matter more closely and to report at the next meeting. The committee consists of Messrs. T. F. Holgate (Northwestern), E. B. Van Vleck (Wisconsin), L. E. Dickson (Chicago), A. G. Hall (Michigan) and E. J. Wilczynski (Illinois).

Mr. Toastmaster and Gentlemen: It is a difficult task which I have to fulfill to-night, to hold your attention after a hard day's work of mathematical deliberation, at a time when the average man seeks repose in friendly conversation. But I shall not attempt to excuse myself, and hope that you will pardon this rather unusual proceeding on account of the interest and the importance of the subject.

We have come together as mathematicians, but most of us are at the same time men in academic life and as such are naturally eager to examine our existing institutions, to inquire whether they are the best conceivable under the circumstances, and if not, to attempt to improve them.

I doubt whether it is necessary for me to spend much time upon an attempt to convince you that all is not as it should be in our American methods of university appointments. We all know of cases where these methods have failed to accomplish the best results, namely, to secure the best man available at a given time for a position then open.

Many of our universities and colleges make honest efforts to solve this problem for themselves, and would probably welcome any movement which would assist them in its solution. Others are indifferent, while still others almost openly practise favoritism of the rankest kind. Many of our smaller institutions rely to a considerable extent upon recommendations made by larger and more influential universities, and the latter have a tendency, quite pardonable under our system, of recommending only their own graduates. Again many of these same universities in filling vacancies in their own staff, never would consider a candidate unless he had been one of their own students. The question of personal acquaintance counts too much; whether a man is a good fellow, or a man of conservative political and religious beliefs, whether his personal appearance is prepossessing, or whether his social attainments render him desirable, all of these questions are quite frequently weighed more carefully in the balance than these others: is the man a scholar, and can he teach? If he *is* a scholar, unless he has some good friends to speak for him, the presumptions are all against him. It is assumed almost as a matter of course that he can not be also a good teacher, and it seems practically certain that he can have no executive ability. Unless the photographer has been especially kind to him, his looks will probably not be satisfactory.

To return, for a moment, to the question of teaching ability; this is certainly one of the important points to be considered in the making of many and perhaps most appointments. But what methods have we for obtaining any positive or reliable information on that point? I think you will all admit that in most cases the evidence on that score might as well be dismissed; it usually consists of the statement of a few persons who may or may not be qualified to judge, and who may or may not know anything about the qualifications of the candidate as a teacher.

I wish to pass in review, rapidly, the methods employed in other countries in making university appointments, so far as I have been able to discover them.

The German system is fairly familiar. The faculty concerned makes recommendations to the minister of public instruction. There is no systematic and public canvass for the purpose of ascertaining the best man; the responsibility of making the recommendation is not fixed upon any particular man or group of men, but upon the faculty as a whole. Since the deliberations of the faculty are not public, any criticism of an appointment once made can not with any degree of certainty be directed toward any particular member of that body. While the system is, I believe, far better than our own and has in most cases given good results, it has often worked great injustice, making possible discriminations for personal or other reasons which under a better system might have been avoided.

I wish I could speak to you about an English system. But my attempts to find out about it have only led me to conclude that no such thing exists. Each of the universities in Great Britain apparently has its own methods of procedure in selecting its officers of instruction; each of the colleges which forms a part of the university again

has a different system, and the methods vary considerably even within the same institution for appointments of different grades. My source of information, one of the professors of Cambridge University, assures me that it would be a very formidable task to attempt to enter upon a comparative study of the methods of appointment in the English universities. Speaking of Cambridge, he says: "Certainly, for any trustworthy information about this place, a small pamphlet (perhaps it might not be small) is required." Under these circumstances, I feel compelled, in my discussion, to cross the channel to France, where a very simple and effective method is in operation.

The instructing staff of a French university is composed of professors (professeurs titulaires), chargés de cours, whom we shall here call assistant professors for the sake of convenience, and maîtres de conferences, whom we shall call instructors. The latter conduct their courses under the direction of a professor, the subject being frequently assigned to them by such a professor. The assistant professor conducts his course independently, being temporarily in charge of a professorial chair; he therefore plays the part of a professor without having professorial rank. A limited number of these assistant professors may be appointed professeurs-adjoints (let us say associate professors). This distinction affects neither the character of their work nor their salary, but merely gives them the right to take part in the deliberations of the council of the faculty. This council, composed of the professors and associate professors, has jurisdiction over a number of questions in which the faculty is interested, among others those concerning appointments. An associate professor, however, has no right to vote on the appointment of a full professor. Certain other matters are decided by the whole faculty (Assemblé de la Faculté), composed of all of its members, including also the instructors.

If a professorial chair in a French faculty of science is vacant, the council of the faculty may or may not declare officially the existence of a vacancy, after which the chair is filled temporarily for a period of varying length by a chargé de cours. The minister of public instruction then inquires of the council whether it wishes the chair to be maintained, suppressed or transformed. If the chair is maintained or transformed, the candidates, who must be at least thirty years of age and in possession of the doctor's degree, are given twenty days to hand in their applications, publications, recommendations, etc. After the expiration of this period the faculty presents a list of two names (first and second choice) to the minister of public instruction. But there exists a body called "Section permanente du Conseil supérieure de l'Instruction publique," composed of a number of scholars and high officials of the ministry of public instruction. This committee likewise presents a list of two names to the head of the department of public instruction, who may legally choose either name on either list. It is possible, therefore, that the new professor may not be one of those requested by the faculty. But such cases are very rare and arouse violent protests when they present themselves. Generally the first choice of the faculty is appointed.

There is no law requiring the minister of public instruction to consult the faculty in the appointment of assistant professors and instructors. As a matter of fact, however, this is always done, and except in one or two cases the wishes of the faculty have always been respected.

This system, which has some strong points, has given satisfaction. Still it does not seem to differ very materially from the German method, and seems to me to be much inferior to the Italian, which I shall now proceed to describe.

If a professorship in an Italian university is to be filled, the fact is advertised a long time beforehand in the official journal of the department of education, notices to this effect being also posted on the bulletin-boards of the various universities throughout the kingdom, as well as in other appropriate places. Anybody who thinks that he has any claim upon the position may apply. His application must be handed in by a certain date. It must include an account of his previous career, accompanied by the proper documents, diplomas, etc., a list of his publications and five copies of as many of these as possible. Most of the other documents are also required in five copies, for a reason which will immediately become apparent.

In the meantime the faculties of all of the universities of the kingdom are asked by the minister of public instruction to present him with a list of five men, these to be members of a committee whose purpose it shall be to judge the applications and to make a nomination. Each of the universities thus registers its choice as to the five men whom it considers the most competent judges in the case. They are, naturally, all specialists in the subject of the vacant professorship or else in closely allied subjects. These lists of five are again printed in the official journal. Five of the ten men who receive the highest number of

votes, the vote of each university counting as one, are then chosen by the minister of public instruction as members of the committee.

The responsibility for a selection now rests upon this committee. Each of the members individually examines the applications, and considers the relative merits of the candidates. Finally the committee meets as a whole in Rome and decides upon a first, second and third choice for the position. The minister of public instruction offers the position to the first choice; if he refuses, to the second, etc.

This system seems to me to eliminate, about as completely as any human contrivance may, the chances for injustice in an appointment. The complete publicity which attends the various steps in the proceedings, the fixing of the responsibility for a recommendation upon a committee of five of the most representative men of their profession, the democratic and in every way admirable manner of selecting these men, seem to give an absolute guarantee of the wisdom of the final choice. In fact it has worked admirably in practise, and it seems to me that this Italian system is the one which we ought to attempt to adapt to our needs in this country.

Gentlemen, I hope that the discussion of this evening will bear some fruit. If in our country there existed a central authority controlling all of our universities, we might make an effort to have such a system of appointments introduced by law. We are compelled to resort to a slower process, that of forcing a gradual change from our present methods by educating public opinion. But we are members of a great national organization, the American Mathematical Society, and I am going to ask you to support a motion to appoint a committee to investigate the possibility of improving the methods of appointments in our colleges and universities as far as mathematicians are concerned. I hope that you will support the motion; I hope that this committee will find a satisfactory solution of the problem, and that finally other national learned societies will follow our example, so as to improve the status of the American professor not only in mathematics, but in all other subjects.

To show you more in detail what kind of questions such a committee might investigate, I will give a few examples. Do not misunderstand me. I am not attempting to legislate for the committee, I do not hold tenaciously to any of the propositions which I am now going to advance. Their only purpose is to show that there are certain features of this problem which a society like ours can attack with some degree of success, and which would form a legitimate, if difficult, portion of its work.

Would it not be desirable, for instance, if every mathematical vacancy occurring in any of our colleges or universities were advertised in the *Bulletin*, accompanied by a statement of title and salary, grade, character and amount of work, as well as the date of appointment? It may seem very difficult, but may it not be possible to devise a scheme by means of which the society could put at the service of any institution requesting it, its advice in regard to the filling of any particular position? This might be done by means of a committee appointed for this purpose from year to year, or as in the Italian system for the making of one particular appointment. Several such committees might be appointed for the different regions of our country, whose vastness, of course, is one of the great difficulties to be overcome in the working out of such a system.

I have tried your patience long enough. I shall be satisfied if I have convinced you of the wisdom, not of any of the particular things which I have mentioned, but of the general policy of taking this matter under consideration. It is my honest opinion that the American Mathematical Society can render signal service to the cause of education and science in this manner. I feel convinced that it is our duty as free and independent men, as citizens of the academic world to take this step, which may lead toward a better condition of affairs, where merit will receive its just reward, where all proceedings will be open and frank, where there will be no place for incompetence and injustice.

E. J. WILCZYNSKI
THE UNIVERSITY OF ILLINOIS

GENERA WITHOUT SPECIES

NOTWITHSTANDING the great value of the International Code of Zoological Nomenclature, and the care with which it has been compiled, there remain several important points upon which those professing to follow the code are disagreed. In part, these are due to deliberate omissions, resulting from the impossibility of securing unanimity; but some of them are supposed to be covered by the code, and yet opposite interpretations are made by good authorities. Probably the most serious question of the latter sort relates to generic

names proposed without any definite mention of species to be included under them. The controversy over "genera without species" is especially agitating entomologists at the present moment, because of a proposal to bring into use a number of names for the most common genera of flies, and thus greatly disturb the nomenclature of dipterology. Professor Aldrich has ably contended against this proposal, fortifying his opinion with the code; but another very eminent dipterologist reaches exactly the opposite result, also using the code.

The matter is one which concerns all zoologists and botanists, and whatever may be the ultimate decision regarding it, it will be generally admitted that it is of the highest importance to determine current opinion, as a step toward securing unanimity. With the editor's permission, I will ask for a post-card vote from working zoologists and botanists, and will publish the lists of names in SCIENCE. The vote is asked on the question whether a generic name published without any mention of included species is to be regarded as valid, even though it is accompanied by a definition or diagnosis.[1] It has seemed to me that names so published were rejected by the code, because article 25 states that one of the conditions of the validity of a generic name is "that the author has applied the principles of binary nomenclature." This means, as I understand it, that he must not merely believe in those principles, or apply them elsewhere, but he *must apply them to the case in hand,* to the proposed new genus. If this is correct, I am totally unable to see how he can do this without designating any species by name. In absolute strictness, he ought not merely to designate an included species, but also make the proper combination with the generic name. This is recommended by the present code, but not made obligatory.

Those who take a different view, support their contention by reference to article 2 of the code, which states that "the scientific designation of animals is uninominal for subgenera and all higher groups." This, it seems to me, merely states the obvious fact that the names of subgenera, genera, families, etc., are single words; it does not appear to offer any opinion as to the proper manner of publishing the various designations. Who can define a genus, except as including species; a family, except as including genera; an order, except as including families? It is not possible to upset our fundamental conceptions of these things, any more than it is possible to write sentences without words, words without letters of the alphabet. A genus without species has no type, no content, and apparently has no place in our systems of classification.

On the other hand, various generic names, first proposed without any designated species, have later been given full validity by the designation of specific types, and the publication of the necessary combinations. Some writers have held that when the first mention of an included species was made by some author other than the original one, the generic name should be credited to the author citing or describing the species. I think this should not be strictly necessary, but that while the generic name must be dated from the later publication, it may properly be credited to the original writer, whose work may be considered to be included and republished in the validating work. This is a matter on which opinions will differ, and as it does not affect the names themselves, it is not of the first importance. Another difficult class of cases is that in which a generic name has been proposed with the name of an undescribed species. The late Dr. Ashmead has left us a large number of such genera. If the genus was also without definition, both generic and specific names would be nomina nuda; but I have ventured to hold that any diagnosis of the genus might also be interpreted as a diagnosis of the species (only one being mentioned), and hence both generic and specific names would be available for adoption.

T. D. A. COCKERELL

UNIVERSITY OF COLORADO,
BOULDER, COLO.

[1] This does not include names proposed (on account of preoccupation) to replace others which already have included species. Such cases are covered by the code.

DR. WILLISTON ON "THE FOSSIL TURTLES OF NORTH AMERICA"

IN SCIENCE of December 4, 1908, Dr. S. W. Williston has published a review of my book, "The Fossil Turtles of North America." This review showed as much appreciation of the merits of the book, and as much leniency towards its shortcomings, as its author could desire. However, one or two matters referred to by Dr. Williston seem to require notice; and this is here respectfully presented.

Dr. Williston takes issue with my division of the turtles into the Athecæ and the Thecophora. To this I will say that unless the early turtles separated primarily into the ancestors of the two groups mentioned, these two suborders are not at all worthy of recognition.

As to the resemblances between the leather-back and the other sea-turtles, I will, to illustrate, consider the flippers. The limbs of the primitive turtles were, I believe, not greatly different from those of the snapper, for example. Inasmuch as the ancestors of the leather-back and those of the other sea-turtles started with the same form of fore limb and on entering the water employed this limb in the same way, it is not strange that their descendants have closely similar flippers. The fore limbs of the Trionychidæ have certainly been independently developed, and yet they are being modified in the same direction. Those of *Carettochelys* are another example. If a thoroughly aquatic pleurodire shall ever be discovered it will doubtless have similar fore limbs.

As regards the two dermal coverings of the primitive turtles, I may remark that the early reptiles probably had as great need of armor as their modern descendants. A modern crocodile seems to have need of only a single layer of dermal bones, the so-called abdominal ribs, in the lower wall of its belly; but a cayman requires, in addition to this, an armor of closely jointed bony scutes. The leather-back itself actually possesses the two bony coverings in question. Ventrally the plastron of dermal bones is covered by rows of osseous scutes, while on the upper surface the nuchal bone is found to be overlaid by a portion of the mosaic-like bony armor. Who is to say that never were there under this mosaic of the upper surface also peripheral bones, and even costal plates?

Dr. Williston is certainly correct in holding that the elements that I have called fascia bones are of dermal origin. The dermal bones that had sunken beneath the skin I thus named, in order to distinguish them from a more superficial stratum.

As evidences for the existence of two dermal bony coverings in the primitive turtles I present for consideration the fact that the leather-back has as many longitudinal zones of bony scutes as the most generalized turtles have of horny shields, and the additional fact that the horny shields do not coincide with the bones which they overlie, but break joint with them.[1]

Dr. Williston says that "*Toxochelys* possesses neural ossicles, while the nearly related and less aquatic *Porthochelys* is without them." In like manner, the alligator snapper possesses a series of supramarginal horny shields, an ancient inheritance, while the common snapper has lost them. *Porthochelys* retained the nasal bones, but *Toxochelys* did not.

My friendly reviewer is in error when he states that I hold that in *Toxochelys* there are only vestiges of the inner layer of dermal bones. The nuchal, the costal plates (except that part belonging to the true ribs), the peripheral bones, and the whole plastron, belong to the inner layer.

Dr. Williston mentions the fact that I have omitted mention of two turtles that have got into literature. One of these is from the Dakota sandstone of Kansas, a formation that has furnished no other remains of the order. This specimen[2] is the cast of the cavity of the shell, with indications of some of the ribs. The relationships of the turtle are indeterminable and fortunately no name has been given the specimen. The other turtle referred to was originally briefly described by Dr. Willis-

[1] See *American Naturalist*, XXXII., 1898, pp. 929–948.

[2] *Trans. Acad. Sci.*, XVI., 1899, p. 67, pl. iv.

ton himself.[1] It had been discovered in the Benton beds of Kansas and is stated to consist of some fragmentary ribs and a part of a humerus. The species is supposed to be related to *Protostega*, but here again no name was imposed on the specimen. Dr. Williston pays me the compliment of regretting that I did not describe these materials, with which he could do little himself.

OLIVER P. HAY

WASHINGTON, D. C.,
January 7, 1909

[1] *Kansas Univ. Quarterly*, I., 1902, p. 247.

QUOTATIONS

AMMUNITION AGAINST THE ANTI-VIVISECTIONIST

As antagonism to vivisection is a form of incurable insanity, those who suffer from it are wholly indifferent to argument or facts, and their delusional convictions urge them irresistibly to constant repetition of the same mad acts, quite regardless of consequences to themselves or others. Hence is it that year after year these unfortunate people renew their efforts to secure legislative interference with or prohibition of the experiments with living animals upon which the progress of medical science depends and without which medical practise would be reduced to blind, or at least dim-eyed, empiricism.

That the anti-vivisectionists always find somebody to introduce their bills is a sad commentary on the intelligence of legislators, but this year, as so often before, the battle with well-intentioned ignorance must be fought again. There are now a few more triumphs over disease with which to confront the wild assertions and accusations of the agitators, but dependence must still be placed on arguments the adequacy of which has already been proved a hundred times—so often, indeed, that many of the same people whom they long since convinced have half forgotten essential parts of the evidence upon which the animal experimenters rely as a defense from the hampering restrictions that unreasoning sentimentalists would impose upon one of the most unselfish and successful classes of workers for the common good.

There is danger in this forgetfulness, and to meet it the Committee on Experimental Medicine of the New York State Medical Society has begun the publication of a series of leaflets setting forth clearly and briefly the scientific and medical side of the vivisection controversy. One by Dr. E. L. Trudeau deals with "Animal Experimentation and Tuberculosis," another by Dr. James Ewing takes up with cancer research, and a third by Professor F. S. Lee treats of "The Sense of Pain in Man and the Lower Animals." Dr. Simon Flexner's contribution tells what vivisection has accomplished in the war against infectious diseases, and Dr. S. J. Meltzer discusses "The Function of the Thyroid Gland—an Important Chapter of Modern Medicine." A leaflet of a different kind is one giving eminent lay opinions, among those quoted in it being ex-President Eliot, of Harvard; President G. Stanley Hall, of Clark University; President E. H. Capen, of Tufts College; Bishop William Lawrence, of Massachusetts, and Dean Hodges, of the Cambridge Theological School. Dr. William H. Park takes up the great subject of "Diphtheria," the disease which would still be slaying its thousands had it not been absolutely conquered through vivisection alone.

Copies of these and other leaflets can be obtained upon application at the Academy of Medicine, 17 West Forty-third Street. They are intended especially for physicians, but they are full of ammunition which anybody can use in answer to silly talk about the cruelty or the uselessness of a method of investigation which is neither the one nor the other, but is, on the contrary, one to which animals and men alike are incalculably indebted for relief from pain.—New York *Times*.

AN IDLE CHALLENGE

THIS characteristic communication comes to us from the president of the Anti-Vivisection Society:

TO THE EDITOR OF THE EVENING SUN—*Sir:* Regarding your editorial attack in *The Evening Sun* of January 27 upon a leaflet issued by this society, I would say that I should be glad to have you attempt at our mass meeting (to be held at Car-

negie Lyceum, February 3, 8 P.M.) to sustain your assertions against its accuracy. Miss Lind-af-Hageby will be glad to show you that you are in great error. Very truly yours,

Diana Belais

New York, January 31.

We have received a similar letter from a woman who says she wrote the leaflet. She shall be nameless. It is typical of the light-hearted irresponsibility of the anti-vivisectionists that neither the woman who is responsible for the publication of the leaflet nor the woman who boasts of having penned it offers the least defense of her part in the matter. Instead we are told that a certain young woman from England "will be very pleased to meet any one in debate." This young woman, we may remark, was joint author of a scandalous publication entitled "The Shambles of Science," which the publisher was compelled to withdraw from circulation several years ago, with a public expression of "sincere regret for having printed and published the book in question." We have no desire to enter into any controversy with this woman, who confesses that she has some difficulty in finding opponents at debate in the country of her adoption—a circumstance which does not astonish us in the least.

Mrs. Belais boldly proclaimed the other day that no "unjustified assumptions or allegations" were published by her precious society. We picked up a leaflet and extracted this single passage: "Pasteur and his followers increased a very rare disease called rabies, and are making fortunes out of the anti-rabic virus." To call this an "unjustified assumption" is to state the case mildly. It is nothing less than an infamous and malicious lie. And we maintain that it is a disgusting spectacle to see so great a benefactor of the human race as Pasteur treated in this frivolous manner by a parcel of unscrupulous women.—New York *Evening Sun*.

SCIENTIFIC BOOKS

Biology and Its Makers. By Wm. A. Locy. With portraits and other illustrations. New York, Henry Holt & Co.

It was the purpose of the author of this book to give "an untechnical account of the rise and progress of biology" which "would be of interest to students, teachers, ministers, medical men and others"; "to bring under one view the broad features of biological progress and to increase the human interest by writing the story around the lives of the great leaders." "The portraits [82 in number] with which the text is illustrated embrace those of nearly all the founders of biology." The scope of the volume is best seen from its table of contents:

Part I.—The Sources of Biological Ideas Except Those of Organic Evolution. Ch. I. An Outline of the Rise of Biology and of the Epochs in its History. Ch. II. Vesalius and the Overthrow of Authority in Science. Ch. III. William Harvey and Experimental Observation. Ch. IV. The Introduction of the Microscope and the Progress of Independent Observation. Ch. V. The Progress of Minute Anatomy. Ch. VI. Linnæus and Scientific Natural History. Ch. VII. Cuvier and the Rise of Comparative Anatomy. Ch. VIII. Bichat and the Birth of Histology. Ch. IX. The Rise of Physiology—Harvey, Haller, Johannes Müller. Ch. X. Von Baer and the Rise of Embryology. Ch. XI. The Cell Theory—Schleiden, Schwann, Schultze. Ch. XII. Protoplasm and the Physical Basis of Life. Ch. XIII. The Work of Pasteur, Koch and others. Ch. XIV. Heredity and Germinal Continuity—Mendel, Galton, Weismann. Ch. XV. The Science of Fossil Life.

Part II.—The Doctrine of Organic Evolution. Ch. XVI. What Evolution is: The Evidence upon which it Rests, etc. Ch. XVII. Theories of Evolution—Lamarck, Darwin. Ch. XVIII. Theories Continued—Weismann, De Vries. Ch. XIX. The Rise of Evolutionary Thought. Ch. XX. Retrospect and Prospect. Present Tendencies in Biology. Reading List. Index.

This book is of much value and should be placed upon the shelves of all school libraries. Biologists will find it a convenient book of reference. Few readers will be so well informed that they will gain no information from its pages. Of especial value are the portraits, many of which are rare and unfamiliar.

The volume is a compilation. Its author makes free use of other studies in the same field, and accepts, for the most part, the gen-

eral judgment as to the men whose work he describes. These judgments and characterizations are occasionally rather naïvely expressed, but the reader is not often inclined to take exception to them, though in certain instances one must do so. For example: The somewhat extended reference to Ehrenberg's work on the protozoa and the very brief mention of Stein is hardly consistent with the fact that Ehrenberg's work, though extensive, was inaccurate and as a whole made no such valuable contribution to our knowledge of this group as did Stein. Richard Hertwig's influence upon the progress of protozoology has hardly been second to that of Bütschli. In the chapter upon classification no emphasis is laid upon the recognition of the sponges as clearly distinct from and sharply contrasted with all the other metazoa. In the discussion of advances in cytology no mention is made of the evidence that the male and female parents are equipotential heredity, nor is there any reference to the work of Richard Hertwig, Schaudinn and others upon the presence and behavior of generative and vegetative chromatin in the cell, though these subjects are surely as important as recent studies of cell-lineage and regeneration which are mentioned. One wonders if the author's confidence that vitalism is a wholly mistaken conception (p. 181) is justified. Are psychic phenomena chemical and physical?

The descriptions of the men and their work and place in the progress of biology are not so vivid as they are, for example, in Foster's "History of Physiology," but this doubtless is in part due to the greater scope of the book and its necessarily briefer treatment of each man and his period. The treatment impresses one not as masterful, but as faithful, and in general sound. In its reference to modern workers, American students receive disproportionate mention, but in a volume designed for American readers, this is perhaps not unnatural.

The second part, dealing with the doctrine[1] of evolution, is not so satisfactory as Part I. The author might have been more successful in his attempt to condense into brief statement the essential features of the theory. He might well have included reference to isolation as a factor in evolution, and perhaps, even in so condensed a treatment as this, organic selection might be mentioned. The presentation of Mendelism (p. 316) would hardly be clear to any one not already familiar with the subject. The statement (p. 389) that "*sexual selection is almost wholly discredited by biologists*" is of course a mistake. Probably all recognize its past importance among human kind, and some believe that it will in time become of greatly increased importance in human evolution.

A few inaccurate statements, and some of doubtful truth, might well be modified in a second edition. Weismann's theory of heredity was presented in his essays upon heredity some years before the appearance of his volume "'The Germ Plasm' published in 1893." Is it true that "Davenport, Tower and others have made it clear that species may arise by slow accumulations of trivial variations, and that, while the formation of species by mutation may be admitted, there is still abundant evidence of evolution without mutation?" It seems, on the contrary, increasingly probable that fluctuating variations do not form a basis for the evolution of new species. It is difficult to see the author's meaning in his statement (p. 404) that "neither mutation nor natural selection is a substitute for the doctrine of the continuity of the germ plasm," or in the statement (p. 405) that "the body cells are not inherited"; and we can not but object to the form of the statement (p. 406), that "natural selection presides over and improves variations arising from mutation," and to the last phrase in the sentence (p. 316). "In this country the experiments of Castle, Davenport and others with animals tend to support Mendel's conclusion and lift it to the position of a law." Sexual selection in the sense now accepted, though not in Darwin's usage, has no relation to the "law of battle" (p. 413). In view of evidence presented by Poulton in his address at

[1] Theory might be a better word, for the word doctrine carries with it, not logically but actually, a little of the flavor of the word dogma.

the Darwin celebration in Baltimore last Christmas, there is need of modifying the statement (p. 414) that "it is altogether likely that Lamarck was wholly unacquainted with" [Erasmus] "Darwin's work, which had been published in England." Charles Darwin lived at Downe not Downs.

Is it true (final chapter, p. 441) that experiments with "artificial fertilization by changes in osmotic pressure . . . have greatly altered opinions regarding the nature of fertilization, and of certain other phenomena of development," or (p. 442) that "recent advances in physiological chemistry have greatly widened the horizon of our view regarding the nature of vital activities"? Would not both statements be stronger if more modest in their claims for the results of recent research in these most important fields? It is doubtful if even in a popular book of this sort it is justifiable to attempt to state the duration of geologic periods in years (cf. p. 344–5).

One finds in the book some phrases and sentences whose form is not beyond criticism —(p. 443) "studies of a pathological character"; (p. 294) "sheep and other cattle"; (p. 383) "pigeons and other fowls"; (p. 429) Wallace is said to be "notable for the publication of important books, as the 'Malay Archipelago,'" etc.; the phrase "fossil life," is frequently used, once it appears as "fossil vertebrate life"; it seems strange (p. 337) to refer to Leidy, Cope and Marsh as "these gentlemen" instead of these men. They were big enough to deserve the bigger word. Why does it seem strange (p. 335) to speak of Huxley shedding light "*in* the province of paleontology," for the phrase is good and is exactly what *is* meant; or why does one smile when the author refers (p. 190) to Johannes Müller as "one of the lights of the world."

A few errors which escaped the proof reader will doubtless be corrected in another edition. The index is so incomplete as to lessen the usefulness of the book. Many important subjects and men treated in the text are not mentioned in the index. Such a historical account does not soon become out of date. It will surely have a number of editions and its minor defects can readily be removed.

Professor Locy has done good service in bringing together into one volume information as to the development of all the broader phases of biology and in presenting a general view which is, on the whole, so sound and well balanced.

MAYNARD M. METCALF

OBERLIN, O.,
January 29, 1909

The Young of the Crayfishes Astacus and Cambarus. By E. A. ANDREWS. Smithsonian Contributions to Knowledge. Vol. XXXV. Pp. 1–80, pls. I.–X. Washington. 1907.

The European crayfish has been upon the whole exceptionally fortunate in its biographers, for with it are associated the names of such excellent observers as Réaumur, Roesel von Rosenhof, Rathke, Huxley and Reichenbach, whose combined work, and more especially that of Huxley, have made it a classical type in the teaching of modern zoology. It is accordingly a little surprising that the American species, especially of *Cambarus*, which everywhere abound, should have escaped that careful analysis of their habits and development which their importance would seem to demand, until a series of papers extending to the monograph under review was begun by Professor Andrews five years ago.

The distribution and description of the many species, as well as the embryology and physiology of the common *Astacus fluviatilis* of Europe form the subject of a rather extensive literature, while the behavior and development of the young after leaving the egg, and the interesting family life first described by Roesel more than a hundred and fifty years ago, have hitherto received but scant attention. As the author suggests, this neglect may be attributed in some measure to the lack of a complete metamorphosis for which the crayfishes have been distinguished from the time of Rathke. Since their young are invariably hatched in a form which closely resembles the adult, greater interest has been taken in the life histories of marine crabs and shrimp, which, as a rule, hatch from

small eggs and must pass through a long and fascinating series of changes before the adult form and habit are attained. It should be added, however, that in the modern zoologist the lure of the sea is strong, even when crayfish abound in his back-yard and burrow all over his lawn. Roesel indeed complained of the neglect which obscured the life of common things in his day, and recalled the old Latin proverb to the effect that what is daily seen is little heeded.

In the present monograph, as well as in his earlier papers, Professor Andrews has thrown a light on many obscure questions, and has probably added more to our knowledge of the crayfish family life and general natural history than all previous observers combined.

For the first time the habits and development of an American species of *Astacus*, from the Pacific coast, are described, while its young have been reared to a length of two inches and an age of five months, when they have molted twelve times, and reached essentially the adult state. The behavior of these young is subjected to a careful analysis, and the text is illustrated by a series of excellent pen drawings showing in detail the slight but important changes which ensue in the body proper and its nineteen pairs of appendages during the first three stages, or until the young have become independent of their mother. Careful drawings to a uniform scale have seldom or never been made to represent the complete metamorphosis of any crustacean, and students of this important class will appreciate their value in the present case.

The habits and development of *Cambarus affinis* are treated in a similar descriptive and pictorial way, and the author devotes a chapter at the end to the weighing of the differences and agreements found in the two genera, and to certain speculations upon the possible origin of their diverse dependent stages and family life.

Astacus leniusculus lays its eggs, to the number of five hundred in the cases observed, in autumn, probably in October, and carries them attached to its pleopods all winter; these eggs are dark in color, and very large for a crustacean, having a diameter of two and one half millimeters, which accords with the precocious character of the young at birth. Hatching took place in late April and early May, and extended over several days. The young leave the egg in a relatively advanced but quite helpless condition, and if expelled from the mother, as in the case of the marine lobster, they would perish from lack of parental care, for they present a curious compound of embryonic, larval and adult characters. It is at this juncture that the peculiar family life of the crayfish has been developed to tide the young over a helpless period of infancy to complete independence, and the account of this interrelation of parent and child, and the correlated structures and instincts upon which it is based constitute the most interesting part of Professor Andrews's work.

The family relation in this *Astacus* endures for over a fortnight or until the little crayfish has molted for the second time, and is dependent upon a complicated chain of events, which suggests the story of the old woman who went to market to buy a pig. If the egg-stalk does not adhere to a "hair" of the parental swimmeret or to another egg; if the two egg-shells are not themselves adherent; if a certain delicate thread, which is spun as it were from an embryonic molt shed at hatching time, does not itself stick on the one hand to the telson of the young, and on the other to the inside of the inner egg-shell and thus tether the little one to its mother; if, again, a little later, when its leading string has broken, this young one has not been enterprising enough to seize and "hook on" to some part of the egg-glue with its great forceps, the tips of which have been bent into fish-hook form—it comes to certain grief. The result is fatal, at whatever point the chain weakens and snaps.

A few hours after hatching the helpless little crayfishes, still dangling from the "telson-threads," which secure each to the parent, begin to flap their abdomens, and to open and close their big hooked claws. In this way they manage to seize the old stalk of

the egg, and with hooks embedded in its tough chitinous "glue" they hold on literally "for dear life," often grasping the same stalk with both chelæ. So strong was this seizing and holding instinct that the young when forcibly separated from the mother would sometimes lay hold of a suspended string, and were thus successfully reared until the period of dependence was over. Once fixation with the claws is successful, the telson-thread breaks and the young remain thus attached by the claws alone for a period of from four to thirteen days, according to condition, when they molt to the second stage.

At the second molt this crayfish is for the first time free, and soon begins to descend the parental pleopod, climbs over its mother's body, and makes short excursions in the neighborhood, returning again and again to the alma mater and the family brood. Hitherto it has been sustained solely by the generous supply of yolk inherited from its egg-state, but since the egg-stalks and cases, as well as the cast skins which remain attached to the mother, disappear at this time, it is thought that they are eaten by the young and constitute the first direct food that they receive before beginning to forage for themselves.

The second stage *Astacus* develops a strong climbing instinct; it is brilliantly arrayed in red and blue pigments as well as the colors which the transparent skin transmits from liver and yolk. The swimmerets are functional, and the appendages generally are garnished with numerous sensory setæ; but the powerful "propeller" or tail-fan is not completed by the liberation of the sixth and largest pair of pleopods until the third stage is reached. Then the little crayfish becomes very active, voracious and pugnacious, frequently losing its limbs at the "breaking joints" and as freely regenerating them. At the fourth stage the rudimentary first pair of pleopods make their appearance, and probably in the males only.

The *Cambarus affinis*, which Professor Andrews has studied with marked success, lays its eggs in March or April, and carries them about seven weeks. Its eggs are smaller and rather more numerous than in the *Astacus*, and the young are correspondingly less advanced at the time of hatching. They do not leave their mother until the third stage, but are associated with her for about two weeks only, or for nearly the same length of time as in *Astacus*. In this case also at hatching the young are tethered, and prevented from escaping from the mother, but by an "anal thread" of a peculiar character. When this young escapes from the egg it leaves behind it a larval cuticle or molt, which sticks at two points only, on the side of the mother to the egg-membranes which are adherent to her, and on that of the child to a portion of the intestine where its cuticular lining is not at first set free. As a result of the tension this embryonic molt is stretched and crumpled with a tendency to turn the abdominal part inside out. This telescoping and partial inversion of the discarded cuticle is checked by the flat molted plate of the telson with the resultant production of a narrow creased ribbon, the "anal thread," which is firmly fastened to the intestinal wall.

The young of this crayfish attain a length of two inches during the first summer, when they may be fertilized by a male of corresponding age and lay fertile eggs in the following spring. In one case a female which was reared from the egg laid eggs herself in two successive seasons, when about one and two years old, and when somewhat more than two and three inches long respectively. Andrews remarks that since the young of this *Cambarus* reared in captivity not only laid fertile eggs, but since this was repeated in the next or third generation there would seem to be no obstacle to the domestication of this crustacean and rearing of it upon an extensive scale.

The first two stages of the young are thus not only peculiarly modified for association with the parent, but in some way unknown, correlated structures of a most delicate kind, not to speak of instincts, have arisen in both to bring this about. These may be compared to the first three stages of the lobster, in

which the young is not only a true larva, but pelagic. The lobster also makes good use, but in a different way, of a "lost larval molt," which is shed at the time of hatching. In this case also the molt sticks to the mother, that is, to the inside of the inner egg-membrane or chorion, and by being slightly adherent to the setæ or swimming hairs of the larva, helps to pull them out or evaginate them, and thus bring them into position for immediate use. To escape merely from its egg-shells, without losing in the proper manner this inner cuticular molt, is as fatal to the lobster as the premature breaking of the telson or anal threads would be to the crayfish.

The third stage in the crayfish corresponds approximately to the fourth stage in the lobster, in which the animal passes as if by a sudden leap into the adult-like form, but the transition is less abrupt in crayfishes since their most striking larval characters have been lost.

In giving up the free-swimming habits of their marine lobster-like ancestors, the crayfishes have apparently acquired their peculiar family life, and a "crawling instinct" would seem more in accord with the needs of many of the species which inhabit fresh water-courses liable to go dry, or which even burrow deep in the ground to find the necessary moisture.

The larval history of *Astacus* is thought to be "more primitive in having a more complete representation of a lost larval stage still evident in a complete cast cuticle within the egg." But this cuticle is apparently not homologous with that cast by the lobster at birth, the pre-pelagic stage of this form being represented by an egg-stage in *Astacus*. Again, since the family life is more completely developed in *Cambarus*, and the genus is more specialized than in *Astacus*, "we may therefore suppose," says Andrews, "that as *Cambarus* has migrated over the middle and eastern United States it has become split up into the sixty odd species now found and in some, as in *Cambarus affinis*, has made more perfect the association of young and parent already present in the *Astacus* ancestor."

It is further suggested that the apparent relation between acquisition of family life and migration from the sea to fresh water may be illusory, since metamorphosis has already been reduced in the marine lobsters, and since in bays and estuaries which must have been first encountered this dependent relation would seem to be especially valuable.

While it is easy to speculate on the origin of the specific characters of crayfishes, and we might add of any animals whatsoever, he concludes that "the nature and the amount of differences of the hard parts and in the larval history that distinguish one kind of crayfish from another are such as to raise the question whether utility and natural selection have played any part in their formation or in their perfection. All the specific and generic characters of crayfish may be as useless as color differences, and they may have arisen suddenly perfected as we see them, or they may have progressed in certain lines for long periods of time independent of external agencies." Much more evidence is needed before we can conclude that the various parts and functions displayed "have ever in any manner been connected with utility to the species or with the survival or extinction of individuals. Until the contrary is proven we may therefore regard them as the unmeaning by-products of unknown activities in the living protoplasm."

Such criticisms as are suggested in the reading of this careful paper are of a minor character. It does not seem proper to describe the invaginate matrix cells of the epidermis which secrete the cuticular sheaths of spines or setæ as "glands," since all the superficial cells of the epidermis are chitinogenous. Further, it would appear to be less confusing to limit the use of the troublesome term "larva" to the first two stages of the young, and to designate as "adolescent" or "adult-like" those stages in which the adult characters appear most pronounced, unless we resort to some such cumbersome terminology as that proposed by Hyatt.[1] It is certainly objectionable to designate as "larvæ"

[1] Science, N. S., Vol. V., p. 167.

(p. 89) the older young, which have attained a length of over an inch and may be several weeks, or even months, old.

It might appear hypercritical to raise the question whether the walking legs of a higher crustacean like the crayfish have claws (p. 23). Huxley got around this difficulty by using the terms "double" and "single claws" for the forceps of the first three and the "nails" of the last two pairs of legs, respectively, which describe the conditions met with in the crayfish exactly. This, however, does not correct the inappropriate though technical use of the Latin word *chela* for the pincers alone.

It is certain that metamorphosis in the higher crustacea has been reduced or eliminated under very different conditions in the rather numerous cases in which a reduction has occurred, as seen not only in the common lobsters (*Homarus*), but in many deep sea shrimps, shallow water *Alphei* and terrestrial crabs (*Gegarcinus*). As regards the possible influence which conditions of life in fresh water may entail, it is interesting to note that metamorphosis has been practically eliminated, not only in the fluviatile crayfish, but also in *Palæmonetes varians* of Europe and in *P. exilipes*, of parts of the eastern United States, one of the few fresh-water genera of prawns known, and that in this case their immediate marine ancestor, the common little *Palæmonetes vulgaris*, has a metamorphosis both long and complete.

Francis H. Herrick

Astronomy of To-day. By Cecil G. Dolmage, F.R.A.S. Pp. xvi + 363, with 45 illustrations and diagrams. Philadelphia, J. B. Lippincott. 1909.

The fascination of astronomy seems as strong to-day as in the distant past, when some knowledge of the heavens was essential to the every-day life of the traveler and the householder. To-day the compass, not the pole-star, guides the voyager across the seas and deserts; the watch and the calendar have replaced as timepieces the sun and the constellations, yet the interest in matters astronomical never wanes. To a large extent this interest is due to the ever-widening fields of astronomical research. Fifty years ago astronomy was practically confined to a mathematical explanation of planetary motion, with a few dry statistical facts concerning the size, shape and mass of the various bodies. To-day astronomy deals with the bodies themselves, with their physical conditions, their life histories, and the probable stages of their evolution. Physics and chemistry are the tools with which an astronomer of to-day works, photography and the photographic plate have replaced the eye and the hand in picturing the wonders of the heavens. Now this new astronomy appeals more directly to the popular reader than did the mathematical astronomy of the past century: one is more interested in knowing what a body is and how it came into being, than in learning the minute details of the path it is describing. That such is the case and that the interest in things astronomical is general, is evidenced by the increasing number of popular and non-technical books on various astronomical subjects.

The field of astronomy to-day, however, is so broad, it covers so much ground, that it can hardly be adequately treated of in a single small volume. The space in even a large book hardly suffices to give proper account of a single minor division of the great science. A single volume, which attempts to cover the entire field, can be but little more than a general index, pointing out to the reader the divisions of the subject, the relative importance of each, sketching in a broad way the principal facts and the underlying theories of celestial development, and indicating who the real workers are and where special details and facts can be obtained.

Now in some of these particulars the well got up and attractive book of Mr. Dolmage falls short of what such a book might be. If we regard the amount of space devoted to a subject as indicating to a certain extent the importance of the subject, then this volume shows some rather remarkable conceptions. For us the sun is undoubtedly the most important body in the heavens, it is the center

from which is derived the heat, the energy, the life of the earth. The countless myriads of stars and the numerous planets could be blotted out of existence without sensibly affecting our daily life; but if the sun ceased to shine the days of the world would be numbered. Again, the sun is a typical star and only by a minute and careful study of the solar constitution can we ever hope to derive some knowledge of the condition of the stars and the course of stellar evolution. Yet Mr. Dolmage devotes but eighteen pages to the study of the sun, and gives twenty-five to the moon and forty-four to eclipses. Comets, the ephemeral by-products of the solar system, are given just as much prominence as the sun itself. Again, the lines along which modern research is progressing are not clearly set forth, and the reader is often left in doubt as to who are the real workers and leaders in astronomical thought. Too much prominence is given to the opinions of writers of scientific fiction; it is certainly an innovation in a serious work to find H. G. Wells so freely quoted.

The book is well written and well printed, and it may serve the purpose described by its subtitle as "a popular introduction in non-technical language." The illustrations are well selected and many of the photographs are beautifully reproduced. The three views of the moon, taken from photographs made in the Paris Observatory, are exceptionally well rendered in the plates.

CHARLES LANE POOR

The Royal Society Archives: Some Account of the Letters and Papers of the Period 1741–1806, with an Index of Authors. Compiled by A. H. CHURCH, D.Sc., F.R.S. Pp. 73. Oxford, 1908.

A valuable aid to the student who may wish to consult the original communications made between 1741 and 1806 to the Royal Society of London has been prepared by Dr. A. H. Church, to whom we are already indebted for a manuscript calendar of the collection of guard-books designated as "Classified Papers." An earlier collection of letters addressed to the society or its officers, and comprised in forty-eight volumes, was indexed by W. E. Shuckard in 1840. The third set of guard-books, which comprises both letters and papers, consists of 127 volumes and these have been grouped in twelve decades, the letters and papers in each of these being numbered consecutively. The series is designated "Letters and Papers." Although most of the material of the letters was published in the *Philosophical Transactions* of the society, they were edited to a considerable extent, and much of the personal note was removed in this way. From among many interesting items noted by Dr. Church in his pamphlet, we select the following:

Decade I., No. 403. In a letter dated May 4, 1745, R. A. F. de Réaumur says:

> I heartily wish there was in the world as strong a moral attractive power as there is a natural one that might dispose our two nations particularly to seek to unite by mutual acts of friendship and good will.

Decade II., No. 198. An unpublished letter of Benjamin Franklin, dated February 4, 1750, describes certain experiments in killing hens and turkeys by the electric current. Franklin proceeds to relate his personal experience of an electric shock from the apparatus employed:

> In making these Experiments, I found that a man can without great Detriment bear a much greater Electrical Shock than I imagin'd. For I inadvertently took the Stroke of two of those Jars thro' my Arms and Body, when they were very near full charg'd. It seem'd an universal Blow from head to foot throughout the Body, and was followed by a violent quick Trembling in the Trunk, which went gradually off in a few seconds. . . . My Arms and Back of my Neck felt somewhat numb the remainder of the Evening, and my Breastbone was sore for a Week after, as if it had been bruised.

Decade II., No. 494. A letter in Latin from Linnæus, acknowledging his election to the society. A facsimile of this letter is given in Dr. Church's pamphlet.

Decade III., No. 117. A letter, also in Latin, from Josef Stepling, concerning a shower of meteoric stones that fell near Strkow in Bohemia, July 3, 1753. One of these aerolites is now in the British Museum.

Decade IV., No. 84. A letter from the Rev. Wm. Hirst dated Fort St. George, E. Indies, February 25, 1761, offers a careful drawing of a leaf-insect with the remark:

Nature seems to have provided for its security by giving it so strong a resemblance to Blades of Grass among which it is frequently found.

Decade V., No. 60. In a letter dated St. Petersburg, 21 Oct./1 Nov., 1768, in which Leonard Euler alludes to his blindness, occur these words:

As the British Parliament were pleased to reward so generously the slight researches which I had made on the Lunar Theory.

Decade V., No. 80. A letter, dated Rio de Janeiro, November 30, 1768, from Captain James Cook to Dr. Morton, secretary of the Royal Society, wherein Cook writes:

The account we gave of our Selves of being bound to the Southward to observe the Transit of Venus (*a Phenomena they had not the Idea of*) appeared so strange to these narrow-minded Portuguese that they thought it only an invented Story to cover some other design we must be upon.

Decade VI., No. 40. On March 24, 1774, a paper was read by Edward Spry, a well-known surgeon of the day, explaining his antiseptic treatment of amputations by the use of a special dressing, "preventing putrescence."

Decade VI., No. 119. Professor John Winthrop, of Cambridge, Mass., described, in a letter dated November 16, 1774, a pictorial hieroglyph inscribed on a rock twenty miles south of Boston, on the Taunton River.

Decade VIII., No. 1. Writing to Sir Joseph Banks, Sir William Herschel names a new star, Georgium Sidus.

Decade IX., No. 27. A paper of 19 pages communicated by Pierre Laporterie under date of August 14, 1786, and entitled "Saphir crystal, susceptible de l'étoile a six raions"; not printed.

Decade X., No. 65. Paper by Sir William Herschel on the "Quintuple Belt of Saturn"; read December 19, 1793; not printed.

Decade X., No. 70. Letter of Alessandro Volta regarding Galvani's discoveries; read in January, 1794; not printed.

Decade XI., No. 93. An account of the Andaman Islands and their inhabitants, by Captain Archibald Blair. 82 pages and map; read April 4, 1799.

Decade XII., No. 28. Description of what he calls a pulmonary calculus, by Philip Crampton. This concretion was seven inches in diameter and weighed 845 grains.

In addition to the names mentioned above, the following are especially noteworthy: John Abernethy, Abbé Jean Jacques Barthélemy, G. B. Beccaria, Comte de Buffon, Charles Burney Mus. Doc., Hon. Henry Cavendish, Duc de Chaulnes, Richard Chenevix, Erasmus Darwin, Sir Humphry Davy, Sir William Hamilton, Rev. John Lightfoot, Jean Hyacinthe de Megalhaens, P. L. M. de Maupertius, Rev. Joseph Priestly. The index contains more than fifteen hundred names, and enables the student to refer without delay to each paper or letter in the collection.

GEORGE F. KUNZ

SPECIAL ARTICLES

A REVISED CLASSIFICATION OF THE NORTH AMERICAN LOWER PALEOZOIC[1]

CLASSIFICATIONS of stratigraphic subdivisions are bound to change with the expansion of our knowledge of detail, so that the most recently accepted must still be regarded as a tentative one, to be replaced by a better one when needed, and the knowledge of facts warrants it. The generally accepted classification of the Lower Paleozoic of North America, proposed by Clarke and Schuchert in 1899, is now in part out of harmony with known facts, while recent interpretation of previously known facts still further suggests the desirability of modification. For *the Cambric system* Clarke and Schuchert retained essentially the classification of Walcott, which, so far as it is applicable to the facts, is a perfectly satisfactory one. The Lower Cambric or Georgian, however, is typically developed only in the Appalachian and western provinces together with the corresponding regions of northeastern and southern Asia. The Atlantic province both of America and Europe

[1] Abstract of a paper read before the joint meeting of the New York Academy of Sciences and eastern geologists, April 6, 1908.

is known to be distinct, and the Holmia fauna of this province has few, if any, types in common with the Olenellus fauna of what might be called on the whole the Pacific province and its various intracontinental extensions. For that reason it would be well to restrict the term Georgian, and its paleontological equivalent, *Olenellus fauna,* to the Pacific province, and to adopt Matthew's term, Etcheminian (including Coldbrookian) for the Lower Cambric of the Atlantic province of America and Europe. For the corresponding fauna the term *Holmia fauna* should be adopted, since the term Olenellus fauna, now generally applied to this *fauna without true Olenellus,* is not only incongruous, but inevitably misleading; for it implies physiographic conditions which are now known not to have existed.[3] The Middle Cambric best known is that of the Atlantic province with its Paradoxides fauna. For this, the recognized term Acadian is most appropriate. This name, used by Matthew for the lower division of his St. John group, is thus extended to include the lower half of the Johannian, or middle division of that group. It might be desirable to use a distinct name for the Middle Cambric of the Pacific (inclusive of Appalachian) province, since these provinces were perhaps even more distinct than in Lower Cambric time. The Upper Cambric was for a long time called Potsdamian. Recognizing the unsuitableness (except in a historic sense) of this name, Walcott has proposed Saratogan to replace it. Though much better than the old name, this is still extremely unsatisfactory, because at Saratoga only the upper and in many respects least characteristic portion of the series is known. It is doubtful if the Saratoga section represents more than the Tremadoc division of the European Cambro-Ordovicic transition; and aside from *Dicellocephalus,* its trilobite fauna scarcely represents the Upper Cambric.

[3] It should be noted that the North Scottish occurrence of the Olenellus fauna is clearly distinct from the Atlantic province, as repeatedly pointed out by Geikie. It probably belongs to an Arctic extension of the Pacific province.

On the Atlantic coast, the upper Johannian and the greater part of the Bretonian of Matthew's St. John group represents a typical Upper Cambric series in close harmony with that of Europe, with which it shows a striking paleontologic correspondence. The best development is on the island of Cape Breton, where its thickness approaches a thousand feet, if it does not exceed that, and where it includes the characteristic faunal zones of Europe. The upper part of the Bretonian of Matthew includes basal Ordovicic beds, the line between this and the Cambric being generally drawn at the summit of the zone with *Asaphellus homfrayi,* the equivalent of the Tremadoc. This section forms a better standard for the Upper Cambric than any other known in America, and the name *Bretonian* would be most appropriate for it. Its meaning would have to be extended so as to include the upper part of the Johannian of Matthew, which term would then be discarded, while the beds above the Tremadoc horizon should be separated from it. This readjustment would not be very different from that which makes Acadian in its wider sense include the lower half of the Johannian, in addition to the Acadian in its narrower lithologic sense. Since the provinces of the Upper Cambric were less distinct, one name would suffice, but that should be Bretonian or some other equally appropriate name, rather than Saratogan or Potsdamian.

The *Ordovicic system* has undergone a variety of classifications. At present the one generally accepted includes the Beekmantown and Chazy in the Lower, as Canadian; the Black River and Trenton in the Middle, as Mohawkian; and the remainder as Cincinnatian or Upper Ordovicic. This classification is out of harmony with stratigraphic and paleontologic facts. Stratigraphically, the Canadian represents some five thousand feet of calcareous strata (where developed to a maximum), while the Mohawkian includes scarcely six hundred feet. The Cincinnatian as now understood is also less than a thousand feet thick, and is in part a phase of the Upper Mohawkian. The Canadian includes two distinct faunas, while the faunas

of the Mohawkian and Cincinnatian are essentially a unit.

In the Mohawk Valley less than five hundred feet of Beekmantown occur, but in the southern Appalachians, from central Pennsylvania south, its thickness is 2,500 feet or more. This, as has been shown by myself[3] and worked out in detail by Berkey,[4] represents a regressional movement of the sea, begun in Lower Beekmantown time and continued throughout; so that the full measure of the depositional series is found only in the non-emerged areas of the Appalachian trough. Northward and westward from this the higher beds fail progressively, the series in central United States being complicated by the desert sands now constituting the St. Peter sandstone. Though it began before the Upper Cambric transgressional movement was fully spent, the greater part of Beekmantown sedimentation was accomplished during a period of emergence of the North American continent.

The Chazy, represented only by its higher beds, the Lowville, in the Mohawk Valley, is nearly 2,500 feet thick in central Pennsylvania, and has a similar thickness in the Appalachians southward. From the region of its greatest thickness, which is also the region of maximum development of the Beekmantown, the Chazy thins northward and westward by failure of its lower members and progressive overlap of its higher. Except in the region of non-emergence, *i. e.*, the Appalachian trough from central Pennsylvania southward, it rests disconformably upon the Beekmantown, the hiatus between the two constantly increasing northward and westward. When present, the St. Peter sandstone marks the plane of this disconformity, though its thickness is no measure of the magnitude of the hiatus. The Chazy thus represents a transgressional series, pronounced in its occurrence over most of North America, but of limited extent in the type region in the St. Lawrence embayment.

[3] SCIENCE, N. S., Vol. XXII., pp. 528–535, October 27, 1905, and *Bull. Geol. Soc. Am.*, Vol. 17, p. 616, 1906.

[4] *Bull. Geol. Soc. Am.*, Vol. 17, pp. 229–250, 1906.

The Black River and Trenton limestones mark the continuance of the transgressive movement. The maximum thickness of the Trenton is less than a thousand feet, and in most places in the east it is partly replaced by the Utica shales. Thus in western New York the limestone referred to Trenton is over 950 feet thick, and the succeeding shales are probably Lorraine with little Utica. Eastward the Utica or black shale phase begins earlier, the higher limestones being replaced by the lower shales. Thus in the type region near Utica the limestone is in the neighborhood of 300 feet thick, and the Utica shale is 700 feet. Still further east, near Amsterdam, the limestone has become reduced to 37 feet, while the shale has increased to over a thousand feet. Northward the limestone increases again to nearly 600 feet in the Montreal region, while the thickness of the shale diminishes. In central Pennsylvania about 700 feet of limestone and 600 feet of shale occur, but in southern Pennsylvania Stose has found that the Trenton is almost entirely replaced by the Utica phase of shale, of which there are almost 1,000 feet of strata. These shales are succeeded by the Eden formation, which in the Cincinnati region rests on Trenton limestone. It thus appears that Trenton limestone and Utica shale represent different lithic and corresponding faunal phases of the same period of sedimentation.

During the succeeding Lower Cincinnati period an extensive retreatal, followed by a readvance movement of the interior North American sea, occurred. As a result, in the marginal portions of this sea, as in the Rocky Mountains, late Richmond rests on early Trenton or earlier beds. In the Appalachian region, extensive continental deposits marked the closing stages of this period, while in the Taconic and Acadian regions, folding was in progress.

As already intimated, three faunas are found in the American Ordovicic: (1) that of the Beekmantown; (2) that of the Chazy; (3) that of the remainder of the series. The Black River fauna is in a measure transi-

tional, and may be classed with either Trenton or Chazy. These faunas and their distinctness in their calcareous as well as graptolitic phases, are well known. The last of these faunas, the Trenton-Cincinnati fauna, is of almost worldwide distribution, characterizing the foreign Upper Ordovicic.

For purposes of intercontinental correlation, the graptolites are most satisfactorily employed. The world over, *Tetragraptus* and *Phyllograptus* characterize the lowest Ordovicic, while *Didymograptus bifidus* further represents the highest part of this lower division. In England, the Arenig rocks include these graptolite zones, and on the continent of Europe and in Australia, etc., this Arenigian division or lower Ordovicic is marked by the same graptolites. In America the shales carrying these graptolites are now regarded as of Beekmantown age, and the correlation of Beekmantown with Arenig is generally accepted. Frech, indeed, draws the line somewhat lower, making the Beekmantown (Calciferous) the equivalent of the Tremadoc and part of the Arenig only. Frech, however, draws the dividing line between the Beekmantown and Chazy below the Fort Cassin beds, so that a part of his Chazy is really Beekmantown in the accepted sense. From this it appears that Lower Ordovicic in America should include the Beekmantown only, applying this term to the formation in its maximum development of 2,500 feet. The term *Beekmantownian* would, therefore, be suitable as an American equivalent of Arenigian or Lower Ordovicic. The Little Falls dolomytes of the Mohawk Valley represent only the lower part of this series, a similar horizon being probably represented by Cushing's "Potsdam" and Theresa formations of northwestern New York. Such a classification would end the Lower Ordovicic with the termination of the great retreatal movement of the sea, which, as shown elsewhere, resulted in the almost complete emergence of the North American continent. The Middle Ordovicic of North America would thus begin with, and be characterized throughout by, an equally great transgressive movement, which, with minor oscillations, again submerged the continent nearly to the extent it had suffered before the emergence.

That the Chazy, with a maximum thickness of 2,500 feet, makes an adequate representation of the Middle Ordovicic can hardly be questioned. Its fauna is distinct, though not without its relationships to both preceding and succeeding faunas. In fact, the Upper Stones River phase of the fauna is so closely related to the Black River fauna that the horizon of the latter is regarded by some as more probably belonging to the Chazy. The Stones River and Lowville faunas seem to be facies faunas of the Chazy, rather than definite indices of the subdivisions of this fauna. Thus while in general the Stones River seems to be a late phase of the Chazy, succeeding the Champlain phase of the Chazy, throughout the interior, the order seems to be reversed in the South Mountain area of Pennsylvania and adjoining districts, where Stose found the Upper Shenandoah to contain a Stones River fauna *followed* by a Chazy-Black River fauna (Chambersburg limestone). Unless there is an error here, the Stones River fauna and typical Chazy fauna (*i. e.*, that of the St. Lawrence embayment) must be considered as contemporaneous. From what has already been said of the relationships of Trenton and Utica deposition, the former must be classed with the Upper Ordovicic. This is further shown by the faunal unity of these formations, many of the most characteristic brachiopods, bryozoa, mollusks and trilobites making their first appearance in the Trenton and continuing through the Cincinnati beds. These types, as already noted, are of wide distribution and are characteristic only of the Upper Ordovicic or Caradocian of Europe and elsewhere, and more especially of the higher zones of this division.

The dividing line between Middle and Upper Ordovicic is drawn in Europe above the zone of *Cœnograptus gracilis*. This graptolite characterizes the Normanskill zone of America, which lies below the Trenton limestone in the Hudson Valley and probably represents Black River horizon if not late Chazy. Ac-

cepting the former equivalency, the dividing line between Middle and Upper Ordovicic should be drawn at the summit of the Black River. This is where Frech draws it, throwing the Trenton limestone into the Upper Ordovicic. In this I believe he is correct, though I am not fully prepared to class the Black River with the lower horizon. Dana's tentative correlation of American and British Ordovicic strata parallels Arenig and Beekmantown, Llandeilo and Chazy, Bala-Caradoc and Trenton, and the lower Llandovery and Utica-Hudson. The lower Llandovery is now referred to the base of the Siluric; the "Hudson" (Lorraine-Richmond) together with the Utica-Trenton thus being referable to the Caradocian.

For the American Middle Ordovicic the term *Chazyan* is here proposed. The old term Canadian would as a result become of no further significance. For the Upper Ordovicic the term *Trentonian* may serve, since Trenton deposition covers at least one half this division. Moreover, the name Trenton Period was used by Dana for Trenton limestone and later divisions. *Nashvillean* would perhaps be a better name, if it is a fact that the Nashville group of Safford covers both Trenton and later Ordovicic formations. *Cincinnatian* is definitely in use for Eden to Richmond inclusive, and though its meaning might be extended to include Trenton limestone, the fact that it is in general use for the higher beds might lead to confusion. The term Mohawkian would, of course, fall into disuse.

In the Appalachian region, extensive fans of continental deposits were formed during late Ordovicic and early Siluric time.[5] In southern Pennsylvania these comprise the basal white beds, generally referred to in the literature as "Oneida," and for which the name *Tyrone* is proposed, from a locality in Pennsylvania where they are typically shown; the middle red beds or Juniata, often called red Medina; and the upper white or Tuscarora, commonly called white Medina. (The Green Pond conglomerates and Longwood shales, and their equivalents in the Delaware and Schuylkill gaps, are not referred to here. They belong in the Salina or Middle Siluric division.) In western New York, the Juniata is represented by the Queenston shales of the present author (red Medina shales of most authors), and the Tuscarora in part by Medina. The Siluro-Ordovicic dividing line falls approximately between these two, *i. e.*, between the Juniata and Tuscarora, or the Bays and Clinch, their southern equivalents. Fossils in the Juniata and Bays (included where the river-laid beds dipped into the sea) indicate their late Ordovicic (Upper Lorraine) age.

[5] These will be fully discussed in a forthcoming paper by the author.

The *Siluric* has been discussed in a previous communication (January 6, 1908, SCIENCE, N. S., Vol. XXVII., pp. 622–23, April 17, 1908), and will be more fully treated in the forthcoming article already referred to. The essential points to be noted are: (1) That the Oswegan of Clarke and Schuchert is now known to be in part Ordovicic and in part Salinan. (2) That the Siluric begins with the Medina sandstone (exclusive of Queenston shales) of western New York, which has a thickness of about 100 feet (Upper Medina of authors generally) and contains a fairly abundant fauna of Siluric age, most nearly related to the Clinton. (3) That the Clinton of the type section in eastern New York includes apparently part of the higher Niagaran beds of western New York. (4) That the pre-"Clinton" Siluric beds of the interior (Cape Girardeau beds; Alexandrian beds of T. E. Savage) are to be classed with the Lower Siluric, for which the term *Niagaran*, used by Dana for all these, is to be restored. (5) That the Middle Siluric is represented only in the interior of North America by the nonmarine Salina, including the Green Pond-Shawangunk and Longwood beds. (6) That the Monroe formation or *Monroan* of Michigan, Ohio and Canada constitutes the true Upper Siluric, the Cayugan of New York (exclusive of the Salina) representing only the uppermost portion of the Monroe series.

Expressed in tabular form, the classifications here proposed are as follows:

Siluric or Ontaric.	Upper Siluric or *Monroan* (900–1,000 ft.)	Upper Monroe (including Manlius, Rondout, Cobleskill and Bertie of New York). Middle Monroe (Sylvania sandstone, only known representative). Partly marked by pronounced hiatus. Lower Monroe (including water limes of Ohio, marine "Salina" of Maryland).
	Middle Siluric or *Salinan* (1,000 ft.)	Represented by the non-marine Salina sediments only in North America so far as known (including Green Pond and Shawangunk conglomerates and the red Longwood shales).
	Lower Siluric or *Niagaran* (1,000 ft.)	Guelph. Lockport. Rochester. Clinton. (Limestones and shales of western New York; Medina sandstone, including Oneida conglomerate, Tuscarora sandstone of Pennsylvania and Maryland and Clinch sandstone of Tennessee.) Cape Girardeau or Alexandrian (a possible equivalent of some of the Clinton divisions given above).
Ordovicic or Champlainic.	Upper Ordovicic or *Trentonian* (or Cincinnatian, *sens. lat.*, or Nashvillean) (1,000–1,500 ft.)	Richmond. Lorraine (including non-marine sediments; *i. e.*, Oswego and Queenston sandstones and shales of New York, etc., Tyrone and Juniata conglomerates and sandstones of Pennsylvania; Bays sandstone of Tennessee). Eden formation (probably in part represented by Tyrone conglomerate). Utica—Trenton series.
	Middle Ordovicic or *Chazyan* (2,500 ft.)	Black River (including Normanskill shales). Chazy limestone series of Lake Champlain region, and local facies, such as Lowville, Pamelia, Stones River, Chambersburg beds, etc.
	Lower Ordovicic or *Beekmantownian* (2,500 ft.)	Beekmantown limestones and dolomytes, of Lake Champlain, Deepkill and Levis shales; various local subdivisions, as Little Falls dolomyte and probably the so-called "Potsdam" and Theresa formation of northwest Adirondack region.
Cambric or Taconic.	Upper Cambric or *Bretonian*	Upper part of the St. John group of the Acadian provinces and New Foundland (including Potsdamian and Saratogan as upper members, equivalent approximately to Tremadoc).
	Middle Cambric or *Acadian*	Paradoxides and Protolenus beds of Atlantic province and equivalent beds of Pacific province and Appalachian embayment.
	Lower Cambric or *Etcheminian*	Etcheminian shales (including Coldbrookian) of Atlantic province (Holmia fauna).
	or *Georgian*	Georgia lutytes and arenytes, limestones and dolomytes of Pacific-Appalachian province (Olenellus fauna).

Amadeus W. Grabau

Columbia University,
October, 1908

RESEARCH WORK IN CHEMISTRY AT THE UNIVERSITY OF ILLINOIS

On the evening of January 18 the Sigma Xi of the University of Illinois, held an open meeting in the chemical laboratory for the purpose of exhibiting the apparatus and methods used in research work in that department at the university.

In connection with the exhibit the following list of researches now in progress at the university was prepared. A part of these researches are conducted in the department of physiology, and a part in connection with the agricultural experiment station.

Physical Chemistry and Electrochemistry: DR. WASHBURN and DR. LACY.

E. W. Washburn: New determination of the electrochemical equivalent. Simple method for deriving thermodynamic equations.

D. A. MacInnes: Freezing point, electrical conductivity and viscosity of solutions of cæsium nitrate and lithium chloride.

O. C. Stanger: Heat of dilution of cane sugar solution.

Grinnell Jones: Negative coefficient of expansion of silver iodide.

G. McP. Smith: Reversible metallic displacements in aqueous solutions.

H. C. Bennett: Electrolytic preparation of alkali and alkali earth amalgams.

Inorganic Chemistry: DR. BALKE, DR. HOLMES, DR. SMITH, DR. ISHAM, DR. JONES.

C. W. Balke: Atomic weight of tantalum.

L. H. Almy: Double fluoride of columbium and tantalum.

J. T. Nuttall: Double fluorides containing thallium and aniline.

J. E. Egan: Rare earths.

G. McP. Smith: Substituted ammonium amalgams. Determination of the density of gases by diffusion.

Helen Isham: Ferrates.

Mabel Gridley: Compounds containing hydroxylamine of crystallization.

W. B. Holmes, W. E. Knapp: Boiler water reactions.

C. E. Millar: Determination of cadmium.

V. R. Ross: Action of hydrochloric acid on manganese dioxide.

W. G. Eckhardt: Use of hydrofluoric acid in soil analysis.

Organic Chemistry: PROFESSOR CURTISS, PROFESSOR NOYES.

R. S. Curtiss: Derivatives of malonic acid and 1.3 diketones.

J. A. Kostalek: Nitrogenous acid derivatives of ethyl malonate.

F. Grace Spencer: Tartronic ester derivatives.

E. K. Strachan: Action of haloid acids on ethyl oxomalonate.

H. S. Hill: Alcohol condensations with ethyl oxomalonate.

J. J. Miller: Action of nitrous anhydride on 1.3—diketones.

G. T. Davis: Acyl peroxides.

W. A. Noyes: Molecular rearrangements in the camphor series.

C. G. Derick: Laurolene.

E. E. Gorsline: Camphononic acid.

Luther Knight: Isocamphoric acid.

Laboratory of Physiological Chemistry: PROFESSOR GRINDLEY.

H. S. Grindley, J. W. MacNeal, F. W. Gill: Effect of saltpeter in meat on metabolism.

H. S. Grindley, A. D. Emmett: Influence of different quantities of feeding stuffs on the metabolism of steers.

F. W. Gill, S. G. Allison, S. R. Wreath: Determination of sulphur.

F. W. Gill, J. B. Peterson: Determination of phosphorus.

R. M. Kibbe, A. F. Wussow: Determination of urea.

F. W. Gill, H. W. Hachmeister: Occurrence and distribution of nitrates in foods, feces and urines.

Physiological Chemistry: PROFESSOR HAWK.

H. A. Mattill: Heat of combustion of the hair of different races.

H. A. Mattill: Methylphenylosazones of levulose and glucose.

C. C. Fowler: Influence of copious water drinking on gastric digestion.

P. E. Howe, H. A. Mattill: Variations in the morphological constituents of the blood and in the "nitrogen partition" of the urine of dogs as influenced by fasting.

DR. PETERS.

Opal Burres: The diastatic enzyme of *Paramœcium* in relation to the killing concentration of copper sulphate.

H. A. Mattill: The diastatic enzyme of ripening meat.

H. W. Stewart: The absorption and partial purification of catalase from liver.

Opal Burres: A chemical and physiological study of some enzymes and toxins from *B. pyocyaneus*.

O. C. Stanger: The action of light, of oxidizing and of reducing agents upon a purified catalase.

J. H. Brown: Th nature and action of the glycolytic enzyme of autolyzing muscle.

R. D. Glasgow: The extraction and properties of lipase from insects.

Industrial Chemistry: Professor Parr, Dr. Mears.

Brainerd Mears: Gas calorimeter.

D. L. Weatherhead: Asphalts.

W. F. Wheeler: Weathering of coal.

J. M. Lindgren: Boiler water.

F. W. Bliss: Occluded gases in coal. Determination of water by the phase rule.

T. R. Ernest, W. S. Williams: Sand-lime brick, and artificial silicates.

E. C. Hull: Distillation of coal at low temperatures.

R. F. Hammer: Ammonia from nitrogenous waste.

W. F. Wheeler: Calorimetric studies.

F. W. Kressman: Spontaneous combustion of coal.

Water Survey: Professor Bartow.

Softening of the water supply of Champaign and Urbana. Clarification of cistern water. Character of water from shallow wells in cities. Municipal water supplies.

L. I. Birdsall: Action of coagulants on Lake Michigan water.

W. C. Marti: Boiler water treatment.

G. A. Van Brunt: Treatment of water with bleaching powder.

Agricultural Chemistry: Professor Hopkins.

L. H. Smith, C. H. Myers: Breeding of corn and other crops to improve the chemical composition.

J. E. Readhimer, W. G. Eckhardt, O. F. Fisher, E. Van Alstine, J. P. Aumer, J. B. Park, Gertrude Niederman: Investigation of factors of fertility for Illinois soils, including work on experiment fields in various parts of the state and also pot experiments.

Robert Stewart: Quantitative relationships of carbon, nitrogen and phosphorus in soils.

L. H. Smith, W. B. Gernert: Transmission of the characters in corn with respect to the chemical composition of the kernel.

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

The annual meeting of the Washington Academy of Sciences was held at the Cosmos Club, Washington, D. C., on Thursday, January 21, 1909.

President Walcott and about thirty members were present.

After receiving and approving the reports of the secretaries, treasurer and editor for the year just closed, the following officers were elected for the ensuing year:

President—C. D. Walcott.

Vice-presidents:

Anthropological Society—Walter Hough.
Archeological Society—Mitchell Carroll.
Biological Society—T. S. Palmer.
Botanical Society—J. N. Rose.
Chemical Society—H. W. Wiley.
Engineers Society—D. S. Carll.
Entomological Society—A. D. Hopkins.
Foresters Society—Gifford Pinchot.
Geographic Society—Willis L. Moore.
Geological Society—A. H. Brooks.
Historical Society—J. D. Morgan.
Medical Society—E. A. Balloch.
Philosophical Society—C. K. Wead.

Managers—1910: Geo. M. Kober, F. V. Coville, Bailey Willis. 1911: L. O. Howard, O. H. Tittmann, B. W. Evermann. 1912: L. A. Bauer, C. H. Merriam, C. F. Marvin.

At the close of the year the statistics of membership were as follows:

Patrons	7
Honorary members	1
Life members	1
Resident members	173
Non-resident members	157
Total	339

The non-resident members are geographically distributed as follows: California, 18; Canada, 4; Colorado, 1; Connecticut, 10; District of Columbia, 3; England, 1; Illinois, 7; Indiana, 5; Iowa, 2; Maryland, 8; Massachusetts, 24; Michigan, 1; Minnesota, 4; Missouri, 5; Nebraska, 1; New Hampshire, 3; New Jersey, 4; New York, 25; North Carolina, 1; Ohio, 4; Pennsylvania, 13; Philippines, 1; Rhode Island, 2; Tennessee, 1; Texas, 1; Virginia, 3; West Virginia, 1; Wisconsin, 4.

During the year 1908 the academy published Volume X. of its *Proceedings*, which contained 248 pages, 2 plates and 12 figures.

On the evening of February 1 Professor Albrecht Penck, of Berlin, delivered before the Washington Academy of Sciences an illustrated lecture on "The Antiquity of Man." Professor Penck kindly furnished the following abstract:

"The antiquity of man dates far back beyond all historical record. It is a purely geological question which must be treated by means of geological observation. It has been known for quite a long time that in western Europe man existed during the glacial epoch. The French geologists and anthropologists, however, who maintained this, assumed only one glacial epoch, while we know to-day that the great ice age consisted of different glacial times separated from one another by interglacial times. The traces of the various glacial epochs consist of moraines of different geological and morphological age, and there is a very strong similarity between the Wisconsin, Illinoian and Kansan moraines of North America and the Würm-, Riss- and Mindel-moraines in the circumference of the Alps, and the Günz-moraines which can be compared with the pre-Kansan moraines of North America. The traces of the interglacial periods consist of deposits with a fauna or flora which is not reconcilable with glacial conditions. The glacial conditions are determined by a lowering of the snow-line of three to four thousand feet below the snow-line of to-day as can be shown by the evolution of old glaciers, while there are indications in the Alps, judging from the corresponding flora, that the snow-line of interglacial times lay about one thousand feet higher than to-day.

"The traces of paleolithic man are found generally outside of the morainic deposits of central Europe, but there are some places where we find those traces above the moraines even of the last glacial epoch, of the Würm or Wisconsin. These are the very well-known stations of Magdalénien near Schaffhausen in Switzerland, of the Schweizersbild and the Kessler Loch. Surely man existed here after the retreat of the ice, but the accompanying fauna is still a glacial one. Man existed here just after the maximum of the last glacial epoch. We have abundant evidence of the existence of man during the beginning of the last glacial epoch as indicated by many paleolithic implements found in the loess deposits, especially those of the valley of the Danube and the valley of the Rhine, which all belong to the Solutréen.

"Of the greatest importance is the occurrence of human relics in the cavern of the Wildkirchli on Mt. Säntis in Switzerland. Here Mr. Bächler discovered, at a height of nearly five thousand feet, together with the relics of one thousand cave bears, several hundred paleolithic instruments of Moustérien type. As we know that the Moustérien is older than the Solutréen and Magdalénien, and since it is quite impossible that man existed here during the glacial epoch, we have to deal here with traces of an interglacial man who had already appeared in the Alps, and this conclusion is corroborated by the fact that the cavern of the Wildkirchli exists in a region which overlooked the old glacier of the Rhine and the local glaciers of the Säntis, so that it was protected against glacial erosion. Probably during the last ice age the whole cavern was filled up with ice, so that the formation of the loam in the cavern ceased and no deposit was forming during the whole glaciation.

"The excavations made by order of the Prince of Monaco in the caverns near Mentone proved indeed that man existed there during the last interglacial epoch, for we find in the Grotto of the Prince beneath the cavern deposits of the glacial fauna, such deposits as an interglacial fauna contain: human skeletons and the implements of the Moustérien type. At other places, especially in France, the Moustérien implements are found together with a glacial fauna. All these localities lie outside of the Riss glaciation, and they are never met with in the realm of the old moraines, as for example, the Magdalénien. We, therefore, must believe that the Moustérien with the cold fauna is contemporaneous with the Riss ice age.

"Quite recently Mr. Hauser has discovered at Le Moustiers a human skeleton, the skull of which is of Neanderthal type, such as has been also found at Spy and Krapina. The recently discovered human jaw of Heidelberg described by Schoetensack belongs evidently to an older interglacial epoch, probably to that very long time between the Mindel and Riss ice ages, where we have also to place the Chelléen implements. Thus we have full evidence that man existed already before the Riss or Illinoian glaciation. Now it can be shown that the time elapsed since the last glaciation is far shorter than the time between the last and the glaciation before the last, between the Würm and Riss ice age. This interglacial time, however, is again far shorter than that long interval between the Mindel and Riss ice age. If, therefore, we have some reasons to believe that the time since the last glaciation was at least twenty thousand years, we must believe that the Heidelberg man dates back about two hundred thousand years.

"Far older are those eoliths found in Belgium and in southeast England. They belong to the early Pleistocene epoch. And indeed we must

expect to find here implements made by early man or his predecessor, but the question is if his predecessor already belongs to the genus *Homo* or to the anthropoid apes. When we discover that the recently extinct natives of Tasmania manufactured eoliths of the same kind as those found in the old Pleistocene gravels of Belgium and England, in the upper Miocene of central France and the upper Oligocene of Belgium, we feel inclined to believe that those implements may not be regarded as *human* artefacts but as having been made by a predecessor of man. Indeed those oldest eoliths occur in a group of anthropoid mammals the genera of which are totally extinct, and it would be very surprising to find that only the genus *Homo* remained unchanged while all other genera developed."

Dr. Merriam remarked upon the Moustérien skull, suggesting that it appeared to be the skull of a child; and called attention to the remarkable differences between the Heidelberg jaw and that of man to-day, a difference so great as to indicate that the Heidelberg jaw may not belong to the genus *Homo*.

Mr. Willis inquired for the evidence that the eoliths found in Tertiary formations were actually shaped by hand and Professor Penck responded by pointing out their peculiar form, one part being shaped as if to hold in the hand and the other part a sharp edge or series of points for cutting. Such eoliths have been found dulled, as if used by man or his ancestor.

Dr. Hough remarked that as man is the only animal that has ever used fire, he desired to know whether or not traces of fire had been found at the various European localities with the other evidences of man, and Dr. Penck replied that traces of fire were found constantly with other evidences as far back as the Moustérien skeleton. No trace of fire was found with the Chelléen implements because they are alluvial and none could be preserved in such deposits.

Dr. Frank Baker called attention to the controversy that had arisen regarding certain prehistoric remains, particularly the jaw of La Naulette. It had been held that the eminences for attachment of the muscles of the tongue upon that jaw were so slight as to indicate that the animal to which the jaw belonged resembled apes in lacking the faculty of speech. Judging from the figures of the Heidelberg jaw displayed on the screen, these eminences were particularly well marked in that specimen, which would argue a special use of the tongue either for speech or for some allied function.

Mr. Spillman referred to the teeth of the Moustérien skull as being like those of a child.

J. S. DILLER,
Recording Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

THE fifth regular meeting of the session of 1908–9 was held at the Chemists' Club on February 5.

The chairman, Dr. L. H. Baekeland, presented the results of an investigation which has occupied his attention for some years under the title, "Bakelite: its Synthesis, Constitution and Industrial Application."

Bakelite is a polymer of an oxybenzoyl-alcohol-methylene-glycol-anhydride having the formula $n(C_{43}H_{38}O_7)$. It is produced by the condensation of seven molecules of a phenolic body with one of formaldehyde. The pure substance is a hard, odorless, transparent mass resembling amber. It is insoluble in all solvents and extremely inert, resisting the action of strong chemicals and high temperatures. In its final form, Bakelite is not a plastic and would have few uses had it not been found possible to control the reaction by which it is formed and prepare intermediate condensation products. These may be incorporated with filling materials such as asbestos and wood pulp, molded into useful forms and finally hardened by the combined action of heat and pressure. The uses of Bakelite are being studied in more than forty different industries with excellent results; for example, in electricity it may be used for insulating devices and impregnating the coils of dynamos; in mechanics for bearings; in chemistry for lining wooden and metal tanks and protecting apparatus; in manufactures for making pool balls, pipe bits and buttons.

Dr. Baekeland's paper will appear later in full in the *Journal of Industrial and Engineering Chemistry*.

The other papers presented were:

M. A. Rosanoff, A. B. Lamb and F. E. Breithut: "A New Method of Determining the Partial Vapor Pressure of Binary Mixtures."

D. D. Jackson and W. A. Horton: "Experiments on the Putrescibility Test for Sewage and Sewage Effluents."

S. A. Tucker, W. A. Alexander and H. K. Hudson: "The Relative Efficiency of the Arc and Resistance Furnace for the Manufacture of Calcium Carbide."

C. M. JOYCE,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 5, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

ADJUSTING THE COLLEGE TO AMERICAN LIFE[1]

FROM a constructive point of view, the existing college represents for the most part tendencies rather than design. It has in the main simply come to be what it now is. True, the gardeners have pruned a bit here and tied up a bit there. But the hedge has been trampled down, and things have been suffered to grow with less regard to the demands of the market than to the fertility of the soil. Provisionally, this style of farming has its advantages. It at least instructs us as to what will grow under given conditions. There comes a time, however, when indiscriminate abundance and variety must submit to a process of evaluation; when wasteful natural productivity is no longer best adapted to meet the demonstrated or calculable needs of a well-defined social organization; when, in a word, we must ask which part of the crop has value, and to what end. This necessity is, I take it, reflected in the question proposed for to-day's discussion.

Two things have happened in higher education during the last thirty years: in the richer and more progressive sections of the country the traditional one-curriculum college has been practically demolished; the graduate school has been evolved. The demolition of the old-fashioned college helped, of course, to make a clearing for the graduate school, and the concurrent growth of the graduate school

[1] An address given before the Section of Education at the Baltimore meeting of the American Association for the Advancement of Science.

hastened the completer demolition of the college. But educationally the two phenomena are not the same. We can neither appreciate nor escape our present plight, until we hold them in thought at arm's length from each other—in thought, for summary geographical sundering of the one from the other is not at this moment advocated, I believe, by anybody.

I say the old college has gone to pieces. But it has not simply gone to pieces, leaving a dust heap to mark its site. It has perished as perishes a frontier town, in the very process of conversion into a modern city. The significant aspects that meet the eye are not so much the evidences of dissolution as the preparations for a new, more commodious and more substantial structure. The college has increased its resources, it has undertaken to serve a far wider range of social activities by frankly conceding the culture-value and dignity of science and of the useful arts. This extension of scope saved it from extinction, at the same time that it procured for the college a far more vital function than it had previously discharged. The historian of our educational history will, I believe, speak of this successful transformation as the great educational achievement of the generation following the Civil War—an achievement destined to be permanently associated with the name and leadership of President Eliot.

On the other hand, from the standpoint of the incoming generation, it is fair to regard the college situation as still undetermined. I have used the word "preparations" advisedly. The college has in hand the elements out of which effective schools may some day actually be made. But they have not been made as yet. Except in the realm of technical education, the college is still almost wholly unorganized. The question inevitably arises whether educational organization at the college level must be limited to the technical field; further, whether it is only the technical instinct that discloses itself during adolescence; finally, whether other types once made out may not be equally amenable to organized educational treatment. In a previous discussion[1] I excluded the technical school, not because it ought to be severed from the college, but because criticism aimed at collegiate chaos does not lie as against the technical departments. I hope now to show that, so far from having no bearing on the academic situation, the technical school, whatever its present defects, is really highly suggestive. The college recognizes the technical motive, stimulates and rewards its expression by providing for it adequate and continuous discipline. It has no fear of wrecking a youth who expects to be an engineer by encouraging him to know his mind at eighteen; in other cases, however, it keeps hands off for fear of doing violence to what is deepest in social and individual activity. Hence, the college outside the technical field now almost entirely avoids definite formulation on the educational side. Once a minimum of content and a maximum of organization, it is now a maximum of content and a minimum of organization.

It is as though a great clearing had been made to which stone and timber, lime and sand have been hauled in large quantities. But neither architect nor builder appears. Meanwhile the neighborhood children play at building with the material. They pile up rambling inconsequential structures that quickly collapse into as many shapeless separate heaps. The brick and stone are college courses; the separate heaps represent individual curricula; the children building without eventual purpose are college students; and the utter absence

[1] "The American College," p. 46, etc.

of connective mortar or controlling design is the elective system!

The college development of the last thirty years amounts, then, from our present standpoint, to educational opportunity rather than educational achievement. Meanwhile the graduate school can not be characterized in similarly negative terms. Its activity in accumulating and refining material represents positive achievement of the highest order. But not college achievement; a serious pedagogical misconception is involved in embracing college and graduate work in a single appreciation. Research is essentially a post-collegiate affair. Not, of course, the research-spirit: that belongs to every stage of modern education; it has its place in the elementary school, in the secondary school, in the college, in each of which the pupil gets some of his motive power from an active curiosity, a distinct tension or problem-sense, far more efficacious in disclosing and disciplining power than a didactic routine smacking strongly of authority. When I urge that the college is not the place for research, I do not say that it is not the place for the research spirit; I do not say that originality, initiative, native reaction on the student's part, are not to be sought after. What I mean is that these essential qualities are not developed only in searching or researching for new material; they are just as readily evoked in situations that are old, provided only the situations be real, pressing, vital and in so far novel to the boy. Thus the research spirit freely stimulated through childhood and adolescence provides background and basis adequate both to suggest and to support genuine problems. Lacking this, problems are given to, not felt out by, the student. This distinction can be made with infinite advantage to both college and graduate school. Failure to perceive it has led to the premature forcing of research and research workers upon the college, as if only thus college studies could be vitalized. Of course, if it is true that research can alone keep teachers from outright ossification, haste must be made to introduce it into the secondary and primary schools, where it is equally important to have teachers who can bend without breaking. The fact is, however, that some men have totally dried up while researching; that others keep their effervescent sparkle without research by cultivating an open and ready responsiveness to novelty, regardless of whether it issue out of the narrow limits of the university laboratory or out of the great laboratory of human life itself. It is absurd to ignore the stimulus of modern life at large and to emphasize exclusively the aspects of activity represented by the academic workshop. All the live men are not laboratory investigators; nor are all the investigators keenly alive. Now then, research in the eulogistic and narrow sense concerns itself altogether with the employment by mature intellects of a powerful technique for the express purpose of increasing or refining knowledge. For this sort of thing the graduate school is the proper place; and the graduate school in its brief history has contributed substantially to increase our intellectual store of precious metal.

The college was enabled at a critical juncture to import generously from the newly established and highly productive laboratories and libraries; but the very bounteousness and suddenness of the enrichment operated to hinder the growth of definite conceptions of college function. The lack of adjustment, which our topic confesses, originates just here. The concern of the college is with students, not with stuff. Adjusting the college to life means the pedagogic assimilation and organization of this accumulated and accumulating material; bringing it to bear

in essential social and individual functions. It does not mean pushing the boundaries of science a little farther into the still unexplored regions of the north, but rather employing our scientific resources to make life itself more highly intelligible and satisfying; it means not delving more deeply for such fragments of historic detail as may have hitherto escaped detection, but making our historic and ethical knowledge tell, in comprehending and rationally modifying what now is. This is a different thing from merely mining for additional facts; a different thing from just getting to know the stock on hand. The business of the college is human and disciplinary, formative and cultural. Its important relations are to *society,* not to *knowledge,* as such; relations *through* knowledge, rather than *to* knowledge. Knowledge is its tool, not its end. From the college point of view, knowledge is just so much raw material, and the more refined, abstract, logically separate and complete, the rawer it is; the more it needs reconstruction, digestion, recombination in ways suggested from the boy's side by genetic psychology, from the social side by the forms into which at a given epoch common activities have been differentiated.

Surely this is what "adjustment" means. When we talk of adjusting the college to life, we mean in plain language working out a concrete educational scheme which will adjust each individual boy to the concrete social situation. Of course this is not all we mean. Education is something more than a mere adjustment. It is also concerned with developing demands on the child's part calculated to upset the existing adjustment. The child must be, in a word, fitted to play his part; straightway that part and the actual social order including it offend his awakened rationality. It is then equally the business of education to fit him to assist in further progress. The college is in this respect but the culmination of, not fundamentally disconnected from, the elementary and high schools. Throughout all these stages of growth and adjustment, education contemplates an actual emergency—a here and now, made up of ascertainable factors. Such a situation can be either superficially or profoundly analyzed in the effort to reach its essential constituents. The elementary school analyzes it largely from the physical and impulsive sides. The high school penetrates farther on the civic and ethical sides; on the individual side, it distinctly seeks to exploit the boy in the hope, among other things, of disclosing the particular way in which he can himself function in society. On both sides the college must proceed still further. Individual differentiation on vocational lines comes in the college period still more sharply to the front; simultaneously, it is all the more important, if the college is to make good the alleged breadth of its discipline, to open the boy's eyes to what is characteristic and significant in the life that is to be the background, basis and standard of all his subsequent activity. An educated man is, in a word, a citizen of the world, of his time, of his nation, just as really as he is a member of a craft, a profession, or a union. And he needs specific training for the former as for the latter.

The common backbone of an adequate educational scheme is thus suggested. Practically the best that the college can now count on in this matter from previous education is a fair knowledge of the facts of our own and English history and some appreciation of the workings and ideals of our own institutions. Hence the college is at once confronted with the necessity of working out a common discipline which will give all students alike a wider outlook,

a deeper grasp of facts, a keener sense of their significance. Unless educated men meet upon such common basis and interest, education, instead of bringing our resources to bear most effectively on the conscious purpose of society, tends to detach disciplined minds from each other and from a common object. The high school comes too soon to do this; the professional school too late. A vague sense of this obligation the college still betrays in clinging to catchwords like "broad," "liberal," "training for citizenship," "training for character." But one can lay one's hands on nothing definite in the curriculum that is actually calculated to make for breadth, liberality or citizenship. The subjects are not there; the treatment is distinctly hostile. At best, special, not general, individual, not basic, needs dictate the composition of the student's course of study. Now, without a curriculum organized and presented with this clearly conceived object in view, what reason is there to believe that the student possesses either the intelligence or the impulse to construct for himself a discipline from which he will emerge with the necessary comprehension and disposition? He lacks the requisite knowledge, purpose and intelligence; and as a democratic society aims to realize not instinctive, but rational ideals, it would be strange indeed if every boy who had read Cæsar and studied algebra already felt the sure ethical and speculative solicitude which it is precisely the task and difficulty of education to develop within him. That is a matter which a society endeavoring to realize conscious ideals through its own corporate action does not leave to the discretion of the individual boy. Of course, it will prize the will or instinct, if he chances to possess it; it will set about creating it, however, if he doesn't. Such training is in the highest sense formative, cultural, human. It suggests a field of college pedagogy which will be opened up for settlement and cultivation when the outposts of research are withdrawn to their own proper territory, just as a secondary school pedagogy will become possible when the college vacates its mechanical and unintelligent control. Contemplating this broad general outlook or basis for all college students, regardless of the special activities which as individuals they may pursue, Professor Mann has recently sketched a college treatment of science that falls in completely with this view:

It would seem, then, that for the normal non-specialist the present instruction in laboratory science, with its wealth of exactness and technical detail, is a misfit. What is needed for these general students in college is a discussion of the bearing of science on the history and present forms of social and economic life, with no laboratory work of the present sort, rather than the customary re-hash of a subject-matter from which the juice should already have been pressed. In other words, the college course in science should try to give to the student who seeks breadth and culture a new and enlarged view of the value and the bearing of science in human life, rather than to fill him with a more detailed and more highly specialized mass of information, which, at his age, ordinarily interests him but little and arouses his enthusiasm even less.

Looked at from this point of view, a course in science in college would be very different from any now given there. If the science were physics, the proposed course might begin with a discussion of the steam engine. Attention should be given to the social and economic changes conditioned by or closely connected with the development of the steam engine, and of its application to manufacture and transportation. When the steam engine was finished, electricity might be taken up in the same way. The electric telegraph and the dynamo and the telephone have certainly affected economic and social life in a powerful way, and played an important part in bringing about present conditions. The entire subject of electricity could easily be brought, if desired, into a discussion of the subject from this point of view. Practical appliances like those just mentioned should not, however, receive all of the attention of the class. The achievements in pure science must not be neglected. Thus the Copernican system of astron-

omy has certainly had a tremendous effect on our intellectual and spiritual life. The important points are briefly these: (1) For the specialist in science or in engineering, college laboratory work of the right sort is an essential part of his professional training. (2) For the non-technical or general student, college laboratory work is neither essential nor desirable; the emphasis in this case should be laid on the services of science in developing and maintaining intellectual, social and economic life.

Thus the college will have made the first step towards a definite adjustment to the conditions of life, when it has worked out a fundamental, common basis which takes up the essential and significant factors of actually extant activities. It has next beyond this a specific duty in reference to each individual, the duty of preparing him for his particular function in just this same society. The particular function of the student must then at this moment be decided: on native lines, if possible, but decided, in any event. As to this I shall have a word to say presently. Just now I point out that the valid scope of election can extend only to such choice of individual function. That choice once made, it is the business of the college to devise the educational procedure that will give it effect. The task is made generally possible of achievement by the fact that modern society has already been differentiated into certain typical forms, a process rapidly going further. The tendency is not without dangers, which would, however, be partly combated by the general cultural procedure already suggested, and partly otherwise. To ascertain what the types in question are and what the lines of training adapted to each, the college must again recur to the existing social situation, in order to discover the forms in which individual energy plays and to work out for each its appropriate pedagogical expression. It is needless to attempt a list of these types now. That again is a task for the college pedagogy yet unborn. Local as well as general conditions here come into play; not impossibly the attempt to recognize and to develop such types may lead to a differentiation among colleges, each of which will then perhaps no longer seek to be all things to everybody. For purposes of illustration, having already touched upon engineering, I confine myself now to the well-defined professions of law and medicine and to trade. In each of these we must organize a curriculum which will constitute an effective preparation for a subsequent training that, once begun, can not afford to concern itself with preliminary matters, and that will also relate the career in question to social life at large. In general, instruction on these lines must be liberally and not just technically conceived. Take the case of medicine. The college will, within its limits, train broadly when, free from any immediate technical responsibility such as exists in the professional school itself, it presents every subject philosophically as well as technically. The student of biology, physics and chemistry is thus on the technical side preparing for the study of medicine; meanwhile the bearing of modern scientific methods and discoveries on the whole trend of social speculation and activity may be simultaneously made clear to him. If we exclude the distractions that are now largely through administrative timidity suffered to consume much of his time and energy, and organize his instruction, as to both substance and method, with a clear notion of what we are driving at, the college years amply suffice for the thorough two-sided treatment of the scientific basis of subsequent medical study.

The argument holds equally in reference to law. I submit that a careful analysis of the function of the lawyer in modern society will suggest a very definite preparation for his career, though the col-

lege now puts no particular pressure upon the future law student to find himself. The lawyer nowadays is two things. He is obviously a practitioner. For this line of activity he can doubtless be admirably prepared by a sharp and severe technical drill in the law school. So far, he is only the clerk of his clients. But he is in reality much more than this. He is the main agent in adapting the great institutional arrangements of society to its progressive movement. As judge and legislator, it is the lawyer who interprets, embodies and guides deep social and ethical currents. True enough, few lawyers as yet appreciate and deliberately prepare themselves to exercise this function; hence their resistant, anti-social, obstructive bias. But the college that seeks to train a race of intelligent broad-gauge men will embrace the opportunity to produce through a profound study of ethical and industrial forces and developments a race of lawyers whose later technical acquisitions and point of view will be conditioned by a large consciousness of their constructive social responsibility. The lawyer is in large measure obstetrician to the future: whether the birth will be painful or gentle depends in no small degree on the skill, intelligence and large-mindedness with which our lawyers frame, apply and judge our laws. We live in a legal and institutional framework that was built to protect us against dangers, many of which no longer exist. Meanwhile totally different emergencies have arisen. The question to be solved through and, to a considerable extent, by our lawyers, is whether these institutions can be adapted to new conditions without interruption of historic continuity. To appreciate their problem, to get in possession of the data bearing on it, the lawyer of the future must rest his specific legal training on an adequate grasp of the tendencies, perplexities and rational ideals that are seeking to utter themselves. Once more, such training must be had in the college, if it is to be had anywhere. I repeat, the high school comes too early; the professional school is too busy and too late. And the training in question must be worked out *for* the boy, not *by* him. That such preliminary training would be in the truest sense liberal as opposed to the immediately technical, vocational or professional, can, I think, not be seriously disputed.

An analogous course of reasoning applies to business. It is perfectly possible even now to organize a course of study calculated to prepare a youth to engage efficiently in commerce and to take broad and intelligent views of the part that at this moment commerce plays in promoting national development and in realizing rational ideals. This, I conceive, would be a liberal, cultural treatment of the trade-motive. That such an attempt would not now be premature, Harvard has proved by organizing a school of business administration. Unfortunately, it is a graduate school, thus illustrating once more the tendency to empty the college of all definite content and responsibility. A student intending to embark in trade is compelled, before he can enjoy the opportunities of the graduate school of business administration, to spend four years in college, doing nothing in particular, before he can at twenty-three get tardy leave to spend two more years preparing to be an intelligent business man. The analogy followed in making the school a graduate school is that of law and medicine: a mistaken analogy, as it seems to me. The student who gets his degree in law or medicine is a lawyer or a doctor. The student who passes through the graduate school of business is not a business man. He has accomplished in reference to business exactly what the preliminary training in biology

and chemistry has done for the intending physician, and analogy would therefore require that the business school become a differentiated college type analogous to the differentiated college types looking forward to law and medicine. The catalogue explains the graduate constitution of the school on the grounds that students must be mature and that the work is specialized and technical. I confess that to me it appears neither more difficult nor more highly specialized than many of the courses provided for undergraduates. Harvard opens to ordinary undergraduates courses in statistics, the economics of transportation, banking and exchange, labor problems, corporation economics, public finance, taxation, railroad practise, principles of accounting, principles of law governing industrial relations, not to mention others like the theory of crises, to which undergraduates may be admitted. Is it possible to make the slightest distinction on the score of difficulty or technicality between the courses just mentioned as open to undergraduates and the following, constituting the business courses, from which they are excluded: economic resources of the United States, industrial organization, banking, railroad operation, municipal business? Neither in the necessary maturity of the students nor in the special or technical character of the topics is there the least difference. The real consideration lies here: the college is so disorganized and usually so averse to definite conception of function and to maintenance of standards adequate to future use, that whatever is serious, organized and definitely purposeful tends to become post-collegiate. Had the college been given to organization and serious standards, the graduate school of business would have made an additional college type resting upon the same general basis as the legal and medical types; and the subjects composing it would be pursued and presented in both their technical and their liberal bearings.

The proposed organization of the curriculum on the basis of differentiated social types differs essentially from the so-called group system. The group system presents combinations on departmental lines: Latin and Greek, biology and chemistry, mathematics and physics. The two subjects forming a group belong, as a rule, closely together, and they enter into combination as linguistic or scientific entities detached as far as may be from practical or social concern—which detachment is, by the way, accounted an advantage from the cultural standpoint. The logical or departmental integrity of the subject becomes thus as prominent in the college as in the graduate school, where conditions and aims are so very different. To my thinking, the college thus goes far towards defeating its own cultural purpose. I do not pretend, of course, that the culture value and the scientific value of biology, for example, are two separable elements; my meaning will be clear from an educational point of view when I say that the cultural importance of biology to the college student comes out when, in addition to his mastery of biological science as such, its history, its applications, its influence on the development of thought, have been explicitly brought forward; when, in other words, the vocational bearing and the social significance of the vocation in question supervene upon the strictly scientific study. Our present college methods of handling science suffer not from too much, but from too little vocational and professional insight. Of course, the vocational handling of biology may readily be just as narrow as the scientific. But an intelligent treatment, such as the college is the place and has the time for, so far from confining the student to mean ends, will open his eyes to

the social and philosophical significance of the activity to which his college studies lead and upon which he will presently embark. Such a treatment the group system, dealing with subjects as subjects, does not essay.

It is, in other words, quite clear that under modern conditions whatever breadth of intelligence the boy attains—and this is, I take it, mainly what is meant by culture—has to be got *through* his activities—social and individual—and not as *against* them or in their despite. This is the fact on which the elective system is based, whether in the unorganized form now in common use or in the organized form which I am urging. So far, a common argument protects both; the diversity of college opportunity corresponds to the diversity of social need. It can not be arbitrarily abridged or reduced. Selection is inevitable; let it be made as economically and effectively as possible. At this point the cultivated man becomes apprehensive. He fears that election dictated by personal bent or professional need may dwarf the student, mind and soul. To some extent this danger will have been frustrated by the common organic basis which, as has been pointed out, should lie below all individual selection whatsoever. Beyond this, the elected studies must be so handled as to avoid the reproach of narrowness. It is in any event inevitable that a rightly elected college course will presage the student's practical destiny. The same factors determine both—capacity or bent, if he has it—otherwise, opportunity, environment. In the common run of cases, unless the student is a Dr. Jekyll in college and a Mr. Hyde out of it, the two phases will be harmonious. The business and glory of the college are then, not stupidly to ignore or vainly to resist the vocational factor, but deliberately to develop in advance its cultural meaning and possibilities. The disappointment with which we now survey results is to be ascribed to our failure to do this very thing.

The main difficulty in putting into operation the policy I have suggested relates to finding proper teachers. I must touch this vital consideration very briefly. The colleges are apt to attribute their pedagogic shortcomings to lack of teachers; I attribute the lack of teachers to the pedagogic shortcomings of the colleges. Our colleges have done little or nothing to develop teachers; they have emphasized, rewarded and competed for specialists. The college function has been lost in the eagerness to encourage research. Now it has at length been found that the two functions are not identical; that men trained to do the one can not equally well do the other. That certain individuals may profitably do both, that the college and the graduate school are closely related, that they may often best flourish in one institution; all this may be admitted, while still maintaining that the crying need of our academic life is for the creation on the part of college authorities of conditions and ideals that will permit a race of college teachers to grow up and to survive.

A college organized along the lines above laid down could, as it seems to me, claim a certain degree of adjustment to modern life, taken as a whole and equally in reference to its constituent activities. I am not unmindful of the fact that such college organization presupposes a different type of secondary school from what we now possess. This opens up a subject I can not now discuss; but I will say this, that an intelligent secondary school pedagogy, such as is already struggling against college pressure to assert itself, may quite conceivably, among other things, succeed in disclosing the youth's essential affinities, dealing with him, as it would, freely dur-

ing the most characteristic and expansive epoch of his life. Despite conditions extremely unfavorable to decisive choice, statistics, roughly compiled for me, seem to indicate that perhaps seventy-five per cent. of the members of the first-year law classes at Columbia and Harvard knew while in college that they would study law afterwards. This would, I think, justify the college in the very definite procedure that I have advocated. In the case of the engineer, the college even now requires an early decision, followed by continuous hard work; it is difficult to see why either the decision or the hard work should be restricted to prospective engineers.

In the last event, supposing that no bent is revealed—and it seems to me absurd to treat the matter as if every schoolboy has some biologically grounded fitness for some one particular calling—I am inclined to believe that it is wasteful and demoralizing to encourage dispersion by the unregulated opportunity to modify, retract and get lost. The college would do better to treat the vagrant with the wholesome rigor that society employs without compunction in the case of the working boy who, in default of a distinct gift or bent, is arbitrarily apprenticed at sixteen. Would it be better if he were maintained as a parasite until such time as he really concluded at his leisure whether he preferred to be a carpenter or a mason?

Several causes have combined to prolong the chaotic condition of the college. In the first place, college administrators have been terrorized or hypnotized by the term culture. For a long while it was identified with a perfunctory knowledge of Latin and Greek grammar and a few books of Cæsar, Xenophon, and perhaps Virgil, and was sharply antithetic to anything that could possibly be of any use. This is mere rubbish. There is possible a liberal or cultural or philosophic treatment of a man's primary practical concern; and the college which does not occupy itself with such interests in just that spirit has lost an important reason for existence. All these antitheses between vocation and culture, science and culture, business and culture, have got to be resolved by a breadth of treatment which absorbs both. Treated in a vital human spirit, every interest of human faculty is culture. The classics may be—and usually are—sterilized so as largely to lose their culture-value; and science may be humanized and thus gain it.

An equally disastrous bogey has been freedom. We are forbidden to adjust the college to existing social conditions through definite organization, subject to revision as society develops, on the ground that the boy can be disciplined to freedom only through freedom. This absolutely negative conception of liberty, having been thoroughly discredited in politics, economics, philosophy, has trekked over into the educational field, after having been shown the door everywhere else. Now in education, as in economics, liberty interpreted as the absence of organization is of provisional service only in relatively brief periods following the abolition of purely arbitrary restrictions. Under such conditions, it allows repressed, ignored, unknown tendencies to disclose themselves; it permits the real factors in a situation to be ascertained, to the end that, once known, they may within limits be controlled in reference to deliberate design. Our real freedom is thus enhanced, not destroyed. We triumph over limitation only by submitting to it. Mr. Santayana says:

> The only artists who can show great originality are those trained in distinct and established schools. It is only in recent times that discoveries in science have been frequent, because natural science until lately possessed no settled method, and no considerable fund of acquired truths. So too in political society, statesman-

ship is made possible by traditional policies, generalship by military institutions, great financiers by established commerce.

To the same effect, President Pritchett has lately said, speaking of education:

Organization which is wise, which respects fundamental tendencies and forces, which separates incongruous phases of activity, may not only add to the efficiency of educational effort, but may offer a larger measure of freedom than can be hoped for in chaotic and unrelated efforts to accomplish the same ends.

Even in the home of academic freedom the force of these words can be illustrated. For the honor degrees at Harvard are conferred only after the completion of certain correlated and combined courses, selected *for*, not *by*, the student. Does not this fact plainly indicate that where seriousness begins, there some form of enforced coordination begins also?

The objection to negative freedom does not, however, drive us back to positive, but arbitrary restriction. Still less can the difficulty be met by the illogical Yale-Princeton compromise, according to which the student gets practically two years of each—the freshman and sophomore years devoted to conventional restrictions, the junior and senior years to negative freedom, qualified though it is by the inevitable mechanical inconveniences of the time-table and a few departmental sequences. In considering only the two alternatives here in question or their combination in equal consecutive parts, the colleges overlook altogether the organic character of a genuine educational solution.

I should like briefly to touch another essential point. It is absolutely futile to talk of adjusting to life an institution of such easy virtue as our present college. Perhaps its demoralization of standards simply expresses the fact that, as it serves no particular educational purpose, it is immaterial whether the student takes the thing seriously or not. But a college organized on the lines I have suggested has no other choice but seriousness. We still bear traces of our English collegiate origin in the familiar twaddle about the college as a sort of gentlemen factory—a gentleman being a youth free of the suspicion of thoroughness or definite purpose. Now, I grant that as long as a single required course was forced upon every student, it would have been absurd to require the same sort of performance of every one. The prospective don could fairly be held to a standard not applicable to the future country squire. But the elective system—organized or unorganized—knocks the props from under the gentleman, or citizen—as he is sometimes called. It proposes to do for each student what he needs. It is thus illogical not to require a high grade of excellence of all alike. Ineffective performance can no longer be excused on the ground of the irrelevancy of the task. The tolerant attitude of the college towards every form of individual capacity and social opportunity compels a serious treatment on both individual and social grounds.

The fact that the college has so frequently demoralized rather than stimulated occasionally leads men who have been developed by the struggle for opportunity to look upon mere abundance of opportunity as itself disastrous. Our strong man of the last generation had to fight for his chance; and that was the making of him. A costly discipline, to be sure, but not altogether a bad one. To-day, far better opportunities than he fought for are easy and accessible. The struggle of our children must then be not *for* opportunities, but *within* them. The college offers the chance, it makes every concession to individual capacity and disposition. It must demand, therefore, a genuine performance at every point. To make opportunities

abundant and standards low is thoroughly immoral.

ABRAHAM FLEXNER
CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

A DANGER ARISING FROM THE POPULARIZATION OF THE COLLEGE[1]

I WISH to speak of a danger which threatens the American college as the result of changes in the work of the college and in its environment whose joint effect may be summed up in the phrase, "the popularization of the college."

The history of the American college begins about the close of the first third of the seventeenth century, Harvard College having been founded in 1637. The traditional college curriculum, which was not radically changed till about the middle of the nineteenth century, was largely due to the intellectual conditions of the seventeenth century. When Harvard College was founded, there was very little to be studied, beyond the rudiments of a common English education, excepting Latin, Greek and Hebrew and a little mathematics. At that very time Descartes was shaping the outlines of the method of coordinates in geometry, but the world had still to wait half a century for the invention of the calculus. A half-century was to elapse before Newton's great discovery of gravitation gave unity to the conception of the universe. Almost a century and a half was to pass away before the discoveries of Priestley and Lavoisier created the science of chemistry. The "Systema Naturæ" of Linnæus did not appear until Harvard College was already a century old. A century and a half was to elapse before geology and paleontology took shape under the hands of Hutton and Cuvier. It was almost a century and a half before Adam Smith's "Wealth of Nations" laid the foundations of the modern study of economics. It was more than half a century before Locke's "Essay on the Human Understanding" opened the discussions of the modern period of philosophy. More than two centuries were to elapse before the study of language took on a scientific form in Grimm's "Geschichte der deutschen Sprache." Two editions had already appeared of the collected plays of Shakespeare, but as yet no one dreamed of English literature as standing on a par with the great classic literatures as an object of study; and still less would it have occurred to any English-speaking educator to think of the literature of any other modern language as a worthy object of study. The ancient languages and a little mathematics formed about all the educational material that was accessible in the seventeenth century, and it was nothing strange that the curriculum developed in the environment of that age survived for a considerable time after the environment had changed. But the old curriculum has now become thoroughly extinct. The new branches of learning which have developed in the last three centuries have come to take a dominant position in the education of youth, as in the thought of manhood. The wealth of educational material at present available is vastly larger than any one can deal with in the brief years of the college course. Everywhere the fixed curriculum has given place to the elective system. With the recognition that the field of learning is so large that no one can secure even an introduction to all departments of it in the college course, the elective system has become a practical necessity. From the vast variety of attractive and useful studies each student is rightly left to select, in

[1] Address given before the Section of Education of the American Association for the Advancement of Science.

large measure, according to his own idiosyncrasies, tastes and professional plans.

With this change in the studies of the college course has been associated a change in the constituency of the college. In earlier days the fixed curriculum of the college was supposed, rightly or wrongly, to be adapted to furnish the best substratum for the subsequent professional training of men who were dedicated to the three pursuits known as the "learned professions"—the ministry, the law and medicine. The members of these professions formed a sharply defined intellectual aristocracy. Membership in that aristocracy was, in large degree, hereditary. The members of these professions constituted what Dr. Holmes has felicitously called "the Brahmin caste" in the American society of earlier days. For those boys who were not destined for the learned professions, and for all girls, the training of the common schools in the three R's was supposed to be all-sufficient. To-day there is no such Brahmin caste. The aristocratic constitution of society has changed to one which is intellectually, as well as politically, democratic. The academies and high schools teach the rudiments of the new learning to boys and girls who have no aspiration for any specially learned professions, but who are to do the common work of men and women in society. In the changes which have passed over society new professions have developed which rival the old learned professions in their demand for advanced intellectual training. The work of the teacher has been evolved into a distinct profession, instead of being merely an incidental and temporary employment for persons who were ultimately to pass into other walks of life. The applications of science in the various useful arts have created a demand for advanced intellectual training on the part of multitudes of men who are destined not to lives of scholastic seclusion, but to lives whose business is with the concrete realities of the material world. There is no sharp distinction between a learned class and an unlearned mass; there is rather an indefinite gradation from the most educated to the least educated members of the community. Now that the sciences of nature, the modern languages and literatures, history, economics and sociology have assumed a dominant position in the college course, the college attracts to itself a much wider and more varied constituency. Not alone the devotees of the ancient learned professions, but multitudes of those who are going into the variety of pursuits embraced under the general name of business, throng to the college, and find there instruction and training which will fit them for larger views of their own calling and for broader service as citizens. The college community has become relatively heterogeneous.

Precisely herein lies the danger to which I have thought it worth while to call your attention. In the olden time it was assumed that every student in college was dedicated to a distinctively intellectual pursuit. His life was to be a scholarly life. Hence a scholarly aim, more or less definitely conceived and more or less consistently maintained, during the college course, was expected on the part of all. Now a large share of college students are looking to something very different from a life of learned seclusion. They are to be in the busy world of affairs; they are to develop the material wealth of the community. The careers for which they are intending to fit themselves will demand intellectual vigor and, in many cases, a considerable degree of special knowledge; but they are not careers that would naturally be called scholarly. Hence there comes a pressure exerted upon college faculties to tolerate a lower standard in the scholastic

work of the college, on the ground that a large part of the young men enrolled in the college have no intention of giving themselves to scholarly pursuits, and can not be reasonably expected to have a scholarly spirit. The trouble is not simply that some men do not study. That was always the fact. No system ever fulfills its own ideal; and in the old days, when it was supposed that all students were preparing to be scholars, the supposition was very far from being exactly in accordance with the reality. But then the men who did not study knew and confessed that they ought to study. Now it is gravely asserted in influential quarters that many students in college ought not to study to any very great extent, and ought not to be expected to study; that, as they are never intending to be scholars, there is no need of their being particularly scholarly even during their school life. Precisely on this ground, then, there is a pressure not only on the part of friends of particular students, but also on the part of influential alumni and alumni clubs and associations, to admit men who are unprepared, to tolerate men who are neglecting their work, and to graduate men who have accomplished very little in the line of study. Especially is such a pressure exerted in behalf of men who are distinguishing themselves as athletes during their school and college life, and in behalf of men who are likely to come into possession of considerable money. In urging the claims of such men for peculiarly lenient treatment in college, it is seriously maintained that it is a good thing for men who are going into business, or any other pursuit not distinctly scholastic in character, to go to college with no intention of doing any considerable amount of studying, and to be graduated without having done any considerable amount of studying. It is urged that, if they spend the four years essentially in the avocations of student life—athletics, social events, amusements, college politics—and, in the occasional intervals of leisure which these exhausting avocations may afford, study enough to pass examinations and to be graduated *speciali gratia*, they will yet absorb from the general atmosphere of the college an influence in the direction of increasing breadth of view and higher ideals in life which will be worth the cost in time and money. I do not believe that this view finds much support among college faculties; but I do believe that continual pressure in this direction actually tends to secure the admission of men with lower standards of preparation, and the graduation of men with lower standards of scholarly achievement, than would otherwise be tolerated. The whole position seems to me radically wrong. The business of a student is to study; and for the individual student to spend the four years in the vocation, and to devote the bulk of his continual and systematic neglect of his time and mental energy to the avocations of student activities, is essentially demoralizing. He leaves college with a weakened sense of responsibility, and a conscience which has grown increasingly tolerant of self-indulgence. He has suffered a distinct loss in those elements of strength of character which qualify a man for noble achievement in any department of human life.

If the evil effect were confined to the individuals directly concerned, it would be less serious than it actually is; for a class of men who are in college not to study but for other purposes, exerts an influence upon the college body in the direction of degradation of scholarship and deterioration of character. Especially strong is this evil influence if the men concerned possess athletic ability, wealth, attractive manners and amiable social

qualities which result in their being recognized as social leaders.

Besides the general pressure in the direction of leniency as regards the standards of admission and graduation, the notion that it is desirable to fill up our colleges with a class of students who have no serious ambition to study, has created a tendency to the more liberal admission of students on special courses. I think there would be substantially unanimous agreement among college faculties in the belief that there ought to be some persons admitted as special students. The opportunities of instruction which a college affords can, without any detriment to those who are taking regular courses leading to a degree, be afforded to certain classes of students whose age, financial condition or other circumstances may make it entirely impracticable for them to complete the college curriculum. Teachers in high schools and similar institutions can often get leave of absence for a year, or for a part of a year, and improve the time in earnest study in college in a department in which they are teaching, and in which they have already attained a proficiency which fits them to take advanced work in college. Men and women engaged in various professional or technical pursuits may, in like manner, gain very much by special courses in the colleges in lines of study connected with their work. In such cases, though the persons may not have completed any of the prescribed courses of preparation for college, they are yet fitted by maturity of age, definiteness of purpose and thorough training along some lines of study or intellectual work, to take up the studies of some departments with great advantage to themselves, and with positive benefit rather than loss to the college. It is sometimes justifiable to admit as special students those who wish to take a somewhat general course of study similar to that which would be required for the bachelor's degree, but whose preliminary schooling has been irregular, and who have not covered exactly any prescribed course for admission to college, though the aggregate of training which they have received may be equal in amount or even superior to that which would fit them for admission to college. This is the case sometimes with those who have commenced professional or technical studies and subsequently awake to the necessity of gaining more of general education. In some cases it is legitimate to admit as special students candidates who are expected eventually to get into a regular course of study and take a degree. But to smuggle into college under the name of special students candidates who have simply made a failure of the preparatory course, through lack of ability or through lack of industry, is an evasion which can not be practised without demoralization of the college. But there are probably very few administrative officers or committees having charge of the admission of students to college, to whom the outside pressure for the practise of such evasions has not come to be a familiar experience.

The principle must be explicitly affirmed, and consistently and at times sternly maintained in practise, that, however widely diversified may be the college course under the operation of the elective system, and however cordially men and women preparing for careers widely different from those involved in the traditional learned professions may be welcomed to college, only those students are welcome who come to study—who feel the genuine vocation of the student, and in whose plans for the years of college life the avocations of student life are to be distinctly subordinate to the great vocation. Within limits by no means narrow, they may study what they please; they may shape their

course very largely with reference to the non-scholastic pursuits which await them after leaving college; if they do not want to study Greek, they may study French or German or Spanish; they may study applications of science, as well as pure science; if they do not want to study philosophy or advanced mathematics, they may study the labor problem, or banking and currency, or commercial geography and commercial law: only let it be understood that whatever they profess to study they must really study. In a college, as in a railroad station, there is no room for loafers. WILLIAM NORTH RICE

THE PALEONTOLOGICAL SOCIETY

FOR some years there has been a growing desire among paleontologists for a society in which students of all branches of paleontology can unite for the promotion of their common interests. Such an organization has now been effected as a section of the Geological Society of America under the name of "The Paleontological Society."

The preliminary correspondence which was begun by Professor Charles Schuchert, of Yale University, early last year, was inspired by the successful meeting of the American Society of Vertebrate Paleontologists in New Haven. This correspondence developed the fact that nearly 60 paleontologists are ready to unite in a general society, and of these, 34 attended the first meeting for organization in Baltimore on December 30, 1908. At this meeting an Executive Committee, consisting of Charles Schuchert, F. B. Loomis, S. W. Williston, David White, H. F. Osborn and T. W. Stanton, was appointed with full power to act for the society.

On February 13, 1909, the Executive Committee met with a special committee of the Geological Society of America in the American Museum of Natural History, New York City, and made a satisfactory adjustment of the relations between the two societies. The committee also prepared a constitution and by-laws and elected the following board of officers for the Paleontological Society to serve the remainder of this year:

President—John M. Clarke.
First Vice-president—John C. Merriam.
Second Vice-president—Timothy W. Stanton.
Third Vice-president—David White.
Treasurer—William D. Matthew.
Secretary—Herdman F. Cleland.
Editor—Charles R. Eastman.

It is expected that all the paleontologists of North America will be enrolled in the membership of the new society before next winter, when its first regular meeting will be held with a full program of papers.

T. W. STANTON

ENGINEERS OF WISCONSIN FORM STATE SOCIETY

THE organization of the Engineering Society of Wisconsin was completed at the first meeting, held at the University of Wisconsin February 24–26, at which some 150 city engineers, general managers of power and traction companies, contracting engineers, superintendents of water and light plants, mechanical and civil engineers, and superintendents of highway construction were present and became charter members.

The officers elected were: *President,* Dean F. E. Turneaure, College of Engineering, University of Wisconsin; *Vice-president,* City Engineer McClelland Dodge, of Appleton; *Trustees* for two years, B. F. Lyons, assistant general manager of the Beloit Gas and Electric Co., and E. P. Worden, mechanical engineer of the Prescott Steam Pump Co., Milwaukee; *Trustees* for one year, E. Gonzenbach, of the Sheboygan Electric Light and Power Co., and City Engineer E. R. Banks, of Superior. These, as executive board, will elect the secretary later.

The new organization will hold annual meetings hereafter for the purpose of bringing together the engineers from all parts of the state interested in the solution of such problems as arise in connection with municipal plants, large construction work, bridge, forest and water-power questions, and light and power production. A wide range of subjects

was included in the program for the initial meeting of the society.

At the opening session, February 24, following the address of welcome by President Charles R. Van Hise, was a presentation of the scope of the highway work of the State Geological Survey, by W. O. Hotchkiss, highway engineer for the survey. A. R. Hirst, also of the state highway department, spoke on the use of tar, oils and emulsions on macadam and earth roads. The discussion on pavements was led by McClelland Dodge, city engineer of Appleton, and participated in by P. H. Connelly, city engineer of Racine; W. G. Kirchoffer, consulting engineer, Madison, and others. City Engineer C. V. Kerch, of Janesville, spoke on the construction of the Court Street bridge in that city.

Interest in the discussion of the conservation of forests and water resources of Wisconsin, a subject presented by State Forester E. M. Griffith, waxed so keen that the paper on "The Water-power Resources of the State," by Professor L. S. Smith, who is engineer for both the state and national geological surveys, was postponed to the following evening. The conservation discussion was led by Senator T. W. Brazeau, and Senator E. E. Brown, Assemblyman J. R. Jones and Professor D. W. Mead also spoke on the subject.

Professor W. D. Pence, who is engineer for the Wisconsin Railroad Commission, opened the second day's program with a description of the organization of the commission's engineering staff. The new problem of standards of gas and electric service was discussed by Professor C. F. Burgess, of the department of applied electrochemistry at the university, who has done important work in enabling the state railroad commission to prescribe a standard for fuel and illuminating gas.

The electric interurban roads of Wisconsin were made the subject of an address by F. G. Simmons, superintendent of construction and maintenance of way for the Milwaukee Electric Railway and Light Company. The day circuit for small towns was discussed by Professor J. W. Shuster, and new forms of arc lamps by W. E. Wickenden, also of the electrical engineering department. Dean Turneaure took the members of the society through the engineering experimental laboratories, explaining the work that is being done there in many lines of research.

The second night was given to a discussion of water powers, W. G. Kirchoffer describing the water supply of the city of Marshfield, and Professor D. W. Mead the subject of hydraulic and hydroelectric power development. Papers on "The Waterproofing of Concrete," by F. M. McCullogh, city engineer of Stoughton; "Municipal Engineering in the Orient and in Porto Rico," by J. T. Hurd and Edwin Wray; "Gas Producers and Small Power Stations," by V. E. McMullen, Beloit, and C. T. Atkinson; and "Madison's Concrete Storm Sewer System," by City Engineer John F. Icke, concluded the convention program.

THE DARWIN CENTENARY

To commemorate the centenary of the birth of Charles Darwin, Professor Vines, Professor Poulton and Professor Bourne gave an "At Home" to the university in the Examination Schools, Oxford, on February 12. There was a large and distinguished gathering, including four of Charles Darwin's sons—Mr. William Darwin, Sir George Darwin, Mr. Francis Darwin and Major Leonard Darwin. Books, letters, etc., of Charles Darwin were shown by Mr. R. W. T. Günther (Magdalen), and Professor Poulton made an address on "Fifty Years of Darwinism." Sir George Darwin and Mr. Francis Darwin briefly addressed the gathering.

THE Darwin centenary was celebrated at Shrewsbury, his birthplace, under the auspices of the Shropshire Natural History Society. Dr. Cosmo Melvill presided, and Dr. Hoyle, of Manchester University, gave an address on Darwin.

THE special business of the meeting of the Academy of Natural Sciences, of Philadelphia, held February 16, was the commemoration of the centenary of the birth of Charles Darwin and of the fiftieth year of the publication of the "Origin of Species." The president, Dr. Samuel G. Dixon, spoke of the in-

fluence of the doctrines of natural selection and evolution on the development of thought and the progress of humanity. Dr. Arthur Erwin Brown, one of the vice-presidents, referred to the fact that the academy had been the first society in America to recognize the importance of Darwin's work and quoted from his letter to Lyell, of May 8, 1860, in which he says: "This morning I got a letter from the Academy of Natural Sciences of Philadelphia, announcing that I am elected a correspondent. . . . It shows that some naturalists there do not think me such a scientific profligate as many think me here." Dr. Brown also read a letter addressed by Darwin to Dr. Joseph Leidy, under date of March 4, 1860, acknowledging receipt of publications, expressing appreciation of Dr. Leidy's work and returning thanks for his support of the doctrine of natural selection. Dr. Edwin G. Conklin, also vice-president, then read a memoir of Darwin dwelling on the importance of his work in science and on the relation of the doctrine of natural selection to modern thought. A collection of Darwin's works and his letter of acknowledgment of election as correspondent of the academy were exhibited.

THE biological and botanical departments of Brown University held a meeting commemorative of the Charles Darwin Centennial on February 12. The program was:

Introductory remarks with exhibition of portraits of Darwin and his contemporaries, by A. D. Mead.

"Darwin's Relation to Theories of Heredity," by Professor W. E. Castle, of Harvard University.

"Darwin's Influence on Practical Breeding in the Work of Luther Burbank," by Dr. George H. Shull, of the Carnegie Institution, Station for Experimental Evolution.

THE State University of Iowa celebrated the Darwin Centennial by two addresses at the assembly of all colleges. Professor C. C. Nutting spoke upon the personal traits of Darwin, and Professor T. H. Macbride upon his contributions to botany. The Baconian Club devoted its evening program to the memory of Darwin and addresses were made on his contributions to zoology, botany and psychology by Professors G. L. Houser, B. F. Shimek and C. E. Seashore, respectively.

THE Society of Arts held a meeting in commemoration of the birth of Charles Darwin at the Massachusetts Institute of Technology. Addresses were made by Professor William T. Sedgwick, of the biological department, and Professor Percival Lowell, non-resident professor of astronomy at the institute and director of the Lowell Observatory at Flagstaff, Ariz.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

Two special recommendations have been made by the executive committee of the Carnegie Foundation to the board of trustees and, having been adopted by the board, have been incorporated in the rules of the foundation. By one of these recommendations the maximum amount of a retiring allowance is raised from $3,000 to $4,000, and by the other the executive committee is directed to grant a pension to the widow of a professor in an accepted institution who has been for ten years married to the professor, the pension to be one half of what the husband would have been entitled to receive. Heretofore the pensions to widows have been only permissory. They have now been raised from discretionary ones to a certain provision by the adoption of the following rule:

Any person who has been for ten years the wife of a professor either in receipt of a pension or entitled to receive one shall receive during her widowhood one half of the allowance to which her husband was entitled.

The rules for the granting of retiring allowances in force January 4, 1909, are as follows:

A normal retiring allowance is considered to be one awarded to a professor in an accepted college, university or technical school, on the ground either of age or of length of service. The term professor, as here used, is understood to include presidents, deans, professors, associate professors and assistant professors in such institutions of higher learning.

In reckoning the amount of the retiring allowance the average salary for the last five

years of active service shall be considered the active pay.

Retiring allowances shall be granted under the following rules, upon the application of the institution with which the professor is connected. Application blanks for this purpose are furnished by the foundation. The ground upon which the application is recommended, whether it is upon the basis of age or upon the basis of service, should be stated in each case.

1. *Basis of Age.*—Any person sixty-five years of age, who has had not less than fifteen years of service as a professor and who is at the time a professor in an accepted institution, shall be entitled to an annual retiring allowance, computed as follows:

(*a*) For an active pay of twelve hundred dollars or less, an allowance of one thousand dollars, providing no retiring allowance shall exceed ninety per cent. of the active pay.

(*b*) For an active pay greater than twelve hundred dollars the retiring allowance shall equal one thousand dollars, increased by fifty dollars for each one hundred dollars of active pay in excess of twelve hundred dollars.

(*c*) No retiring allowance shall exceed four thousand dollars.

Computed by the formula: $R = A/2 + 400$ where R = annual retiring allowance, A = active pay.

2. *Basis of Service.*—Any person who has had a service of twenty-five years as a professor, and who is at the time a professor in an accepted institution, shall be entitled to a retiring allowance computed as follows:

(*a*) For an active pay of twelve hundred dollars or less, a retiring allowance of eight hundred dollars, provided that no retiring allowance shall exceed eighty per cent of the active pay.

(*b*) For an active pay greater than twelve hundred dollars, the retiring allowance shall equal eight hundred dollars, increased by forty dollars for each one hundred dollars in excess of twelve hundred dollars.

(*c*) For each additional year of service above twenty-five, the retiring allowance shall be increased by one per cent. of the active pay.

(*d*) No retiring allowance shall exceed four thousand dollars.

Computed by the formula: $R = A/100(b + 15) + 320$ where R = retiring allowance, A = active pay and b = number of years of service.

3. Any person who has been for ten years the wife of a professor either in receipt of a pension or entitled to receive one shall receive during her widowhood one half of the allowance to which her husband was entitled.

4. In the preceding rules, years of leave of absence are to be counted as years of service, but not exceeding one year in seven. Librarians, registrars, recorders and administrative officers of long tenure, whose salaries may be classed with those of professors and assistant professors, are considered eligible to the benefits of a retiring allowance.

5. Teachers in the professional departments of universities, whose principal work is outside the profession of teaching, are not included.

6. The benefits of the foundation shall not be available to those whose active service ceased before April 16, 1905, the date of Mr. Carnegie's original letter to the trustees.

7. In counting years of service toward a retiring allowance, it is not necessary that the whole of the service shall have been given in institutions upon the accepted list of the foundation.

8. In no case shall any allowance be paid to a teacher who continues to give the whole or part of his time to the work of teaching as a member of the instructing staff of a college or technical school.

9. The Carnegie Foundation for the Advancement of Teaching retains the power to alter these rules in such manner as experience may indicate as desirable for the benefit of the whole body of teachers.

SCIENTIFIC NOTES AND NEWS

THE Berlin Academy of Sciences has awarded its Helmholtz medal to Professor Emil Fischer, for his work on the sugars and albuminoids.

DR. FRANK D. ADAMS, dean of the faculty of applied science and professor of geology at McGill University, has been elected an honorary life member of the Institute of Mining and Metallurgy of Great Britain.

THE Royal Society of Arts has presented its Albert medal to Sir James Dewar, F.R.S., for his investigations into the liquefaction of gases and the properties of matter at low temperatures.

THE managers of the department of archeology of the University of Pennsylvania have awarded the Lucy Wharton Drexel medal, for

important work in exploration and publication, to Professor Rudolph E. Brunnow, for his work in Assyria and in the exploration of Arabia.

Mr. Arthur Hill, regent of the University of Michigan, has made the offer to the board of regents of a bronze or marble bas-relief of President James B. Angell, in commemoration of his eightieth birthday and the valuable services which he has rendered to the university, state and nation. The monument will be placed in the new Memorial Hall.

Dr. Edgar F. Smith, professor of chemistry and vice-provost of the University of Pennsylvania, is recovering from a somewhat serious illness.

Dr. C. C. Clark, associate statistician of the Department of Agriculture, has accepted an appointment as chief of the Bureau of General Statistics and Agricultural Information in the International Institute at Rome.

At the annual meeting of the Royal Astronomical Society on February 12 Mr. H. F. Newall, the president, extended a cordial welcome to Professor O. Backlund, director of the observatory, Pulkowa, Russia, to whom the society's gold medal had been awarded. The Jackson-Cwilt bronze medal and gift were handed to Mr. P. Melotte, of the Royal Observatory, Greenwich, in recognition of his discovery of the eighth satellite of Jupiter. Sir David Gill was elected president of the society for the coming year; Sir W. H. M. Christie and Messrs. J. W. L. Glaisher, H. F. Newall and H. H. Turner, vice-presidents; Major E. H. Hills, treasurer; Messrs. A. R. Hinks and S. A. Saunder, secretaries, and Sir W. Higgins, foreign secretary.

Mr. Eckley Brinton Coxe, Jr., founder of the Coxe archeological expedition from the University of Pennsylvania, and Dr. George B. Gordon, curator of the museum, have sailed for Egypt to join members of the expedition who are working in Nubia.

Dr. J. K. Small, head curator of the museums and herbarium of the New York Botanical Garden, accompanied by Mr. J. J. Carter, of Pleasant Grove, Pa., has been in south Florida for botanical exploration and collecting on the everglade keys, in continuation of his previous work in that region and his studies of the plants of the southeastern United States. Dr. J. A. Shafer, museum custodian in the garden, is in Cuba, commissioned to spend about three months collecting in the northeastern portion of that island, which has been little visited by botanists.

Dr. Hiram Bingham, Jr., instructor in Latin-American history at Yale University, who is now in southern Peru on his South American trip of historical research, is reported to have made important discoveries of Inca remains near Abancay, Peru.

A meeting of the Columbia Chapter of the Society of Sigma Xi was held on March 4 in Fayerweather Hall. "The Sanitary Protection of Tidal Waters" was the topic of the evening, and George A. Soper, C.E., Ph.D., president of the Metropolitan Sewerage Commission, the lecturer. The address described the harmful consequences resulting from the discharge of sewage into tidal harbors and the measures taken to prevent excessive pollution.

Mr. W. H. Finley, assistant chief engineer of the Chicago and Northwestern Railway Company, gave a lecture before the College of Engineering of the University of Illinois on Friday, February 19 on "The Quebec Bridge Failure."

At the 658th meeting of the Society of Arts, Boston, on February 27, Professor Charles E. Lucke, of Columbia University, made an address on the subject of internal combustion engines.

President Taft gave the annual Washington's Birthday oration at the University of Pennsylvania, being presented by the governor of the state. Among those on whom the doctorate of laws was conferred was Dr. Samuel G. Dixon, formerly professor in the university and now Commissioner of Health in the state of Pennsylvania.

President Hadley, of Yale University, made the commemoration day address at the Johns Hopkins University on February 22, which was entitled "Two Sides of University Life."

PROFESSOR E. S. MORSE lectured at Tufts College on February 24 on "Natural Selection and its Application to the Darwinian Theory of the 'Survival of the Fittest.'"

PROFESSOR LIGHTNER WITMER, of the University of Pennsylvania, is giving this term a course of lectures on psychology to the fourth year students of the medical department.

EDWIN KATZENELLENBOGEN, Ph.D. (Leipzig), assistant physician at the Danvers Hospital for the Insane, and fellow for research in logic at Harvard University, is to give a course of lectures on psychopathology, consisting of a treatment of selected topics in abnormal psychology. These lectures, which will be open primarily to graduate students, will occupy one hour and a half weekly. In each month three of the lectures will be delivered in the Psychological Lecture Room; the remaining exercise each month will take place at the Danvers Hospital for the Insane, at Hathorne. Special attention will be given to the legal aspects of psychopathology.

THE Kaiser Wilhelm has recalled his veto of the Virchow monument design and has approved the second sketch. The monument will now be erected on the Karl Platz near the Charité.

DR. WILLIAM TILLINGHAST BULL, professor of the practise of surgery at Columbia University and one of the most prominent surgeons in New York City, died on February 22, at the age of fifty-nine years.

THE death is announced of Sir George King, F.R.S., late director of the Botanical Survey of India, aged sixty-eight and of Professor Julius Thomsen, president of the Royal Danish Society of Science, aged eighty-two.

THE "sundry civil" bill for the fiscal year 1910, as reported to the House of Representatives February 19, provides for a new building in Washington to accommodate the Geological Survey, the General Land Office, the Office of Indian Affairs and the Reclamation Service, to cost \$2,500,000, and appropriates \$100,000 for preliminary work in construction. The site named in the bill is the square bounded by E and F and Eighteenth and Nineteenth streets, west of the building occupied by the State, War and Navy departments and about three blocks west of the White House. For twenty-five years the survey has occupied a rented building on F Street, in the heart of the business section of the city, the annual rental of which now amounts to \$34,900. This building is not fireproof and has been three times visited by destructive fires, the last one, in December, 1908, burning government property worth \$15,000. The annual rentals paid by the survey and the Reclamation Service amount to about \$43,000, and the provision made for the Indian and Land offices in the new building will permit the transfer of other bureaus, now in rented quarters, to a building owned by the government. The annual net saving accomplished will be \$51,400.

THE Yale *Daily News* has made a statistical study of the early training of the 15,142 men, sketches of whose lives appear in Appleton's Cyclopedia of American Biography. 5,326 of these prominent men are college trained, with the colleges, credited with over one hundred, represented in the list as follows: Harvard, 883; Yale, 713; Princeton, 319; Dartmouth, 208; Columbia, 198; Brown, 189; Union, 188; Pennsylvania, 175; Williams, 157; Bowdoin, 104; Amherst, 102. Yale's honor roll is divided among the professions as follows: clergymen, 194; lawyers, 149; educators, 83; statesmen, 55; authors, 53; doctors, 43; scientists, 38; soldiers, 37; business men, 19; journalists, 15; in government service, 14; philanthropists, 6; artists, 4; inventors, 3.

WE learn from the *Journal of the American Medical Association* that the International Bureau of Public Health was formally inaugurated at Paris on November 10, 1908, and the director and secretary were installed in office by the committee, composed of one representative from each of the countries which have agreed to support the newly created bureau. Dr. S. B. Grubbs, of the Public Health and Marine Hospital Service, was the United States delegate. The idea of having a central and international office for the purpose of gathering and distributing information concerning the graver epidemic diseases,

especially cholera, plague and yellow fever, was first presented for consideration at the international sanitary convention of Paris, in 1903, although it had been advocated for some time previously by many sanitarians, notably the late Professor Proust, of Paris. At the request of the convention of 1903, the French government undertook the task of presenting to the nations interested propositions regarding the organization of such a bureau. These propositions were submitted in a final form in August, 1907, and a conference was invited by the government of the French republic, at the instance of the Italian government. This conference was held at Rome, December 3, 1907, the delegates signing for the governments of Belgium, Brazil, Spain, the United States, the French republic, Great Britain and Ireland, Italy, the Netherlands, Portugal, Roumania, Russia, Switzerland and Egypt. It is believed that the exchange of ideas that will take place at the semi-annual gathering of the governing committee will have a beneficial effect on international sanitation. In organization the bureau resembles the permanent International Postal Bureau and the Bureau of Weights and Measures.

In a letter to the editor of the Yale *Alumni Weekly*, in reply to a notification of his accession to the title of oldest living graduate of the university, Chester Dutton, '38, wrote recently as follows:

The position of Oldest Living Graduate is *very temporary* About seven years ago it fell to my early neighbor & friend Mr. L. W. Cutler of Watertown Conn, (Yale 1829), who was a perfect specimen of physical manhood, as well as a man without faults and without enemies, and he held it, I think, for a few weeks.

I recall that more than seventy years ago both Prof. Silliman & Prof. Olmsted predicted many of the wonderful utilities of present day life—Both discussed photography and telegraphy and the use of electro magnetism for power as assured results, only waiting on human ingenuity for methods of production and application. The Ocean Steamer however, the Ocean Cable, & the telephone and the skyscraper—and electrical lighting were not talked of; perhaps not thought of. One problem then regarded with much concern was the future supply of light, as the *whales* were becoming scarce. Petroleum was peddled for *medicine* in pint bottles under the name of "rock oil from Kentucky"—Friction (or explosive) matches had come into use about 1834 or 5, 100 matches in a little box, for 25 cents. Prof. Silliman suggested the probable necessity of governments prohibiting their manufacture & sale, on account their possible use by incendiaries.

UNIVERSITY AND EDUCATIONAL NEWS

At the exercises on February 22 in commemoration of the founding of Johns Hopkins University, which opened thirty-three years ago, it was announced that the gift of Mr. Henry Phipps, of New York, for the psychiatric clinic was considerably in excess of $1,000,000.

A gift of $200,000 to the University of Pennsylvania from an anonymous donor was announced at the exercises on Washington's birthday by provost Harrison. It will be used to establish a department of medical research. The gift was received through Dr. John H. Musser, of the faculty of medicine.

The sons and daughters of the late Mr. and Mrs. F. C. A. Denkmann, of Rock Island, Ill., have promised to give a library building to Augustana College and Theological Seminary, Rock Island, the building to cost not less than $100,000, and to be known as "The Denkmann Memorial Library."

By the will of Dr. Gordon W. Russell, of Hartford, class of '34, Trinity College, receives $5,000 for the natural history department and a collection of books on that subject.

An addition has been made to the observatory building at the University of Michigan, including a new dome 40 feet in diameter. The university is also installing a large reflecting telescope which is now approaching completion, and has been designed especially for photographic and spectroscopic work.

Comer Hall, the new engineering building of the University of Alabama, will be ready for occupancy about May 1. It is a large structure of two stories with a ground-floor space something over three quarters of an acre, and will accommodate the departments of civil, mechanical, mining and electrical

engineering and physics. The cost of the building and equipment will be $150,000. Smith Hall, named for Professor Eugene A. Smith, of the chair of geology, is also nearing completion, and will be occupied by the departments of geology and biology. This building will cost $100,000. An academic building, to be a duplicate of Smith Hall, will be begun in the near future.

AT a session of the committee on education of the Massachusetts legislature on February 24 the establishment of a "Massachusetts College" was considered. The aim of such an institution was explained by Mr. Courtenay Crocker, Mr. Edmund D. Barbour and Professor Thomas A. Jaggar, to be to carry higher education to people not in a position to seek its seats at colleges and universities, to give it at a cost which would bring it within reach of those in less than moderate circumstances, and to furnish a training which would justify the awarding of the degrees of A.B. and A.M. Mr. Barbour has offered to give $100,000 to promote the plan.

THE trustees of Wesleyan University have voted to abolish coeducation in the institution after the class entering in the fall of 1909. It is planned, however, to establish in connection with the university a college for women.

MR. SAMUEL W. MCCALL, congressman from Massachusetts, has declined the offer of the presidency of Dartmouth College.

LORANDE LOSS WOODRUFF, Ph.D. (Columbia), has been advanced to an assistant professorship of biology in Yale University.

ASSISTANT PROFESSOR ROBERT W. HALL has been promoted to the professorship of biology at Lehigh University.

MR. LOUIS A. HERDT, associate professor of electrical engineering at McGill University, will succeed Professor Owens in the chair of electrical engineering.

THE electors to the Waynflete professorship of mineralogy at Oxford have elected Dr. Herbert Lister Bowman, M.A., D.Sc., New College, to the professorship in the place of Dr. Henry A. Miers, D.Sc., fellow of Magdalen, who resigned this chair last October, on his election to the principalship of London University.

DISCUSSION AND CORRESPONDENCE

FOREST PRESERVATION

TO THE EDITOR OF SCIENCE: In a recent number of an engineering paper appears an editorial entitled, "How 'Concrete Lumber' Has Made Forest Preservation a Farce." The article opens with the following words:

> The fast-perishing forests of America have been the theme of many a statistical lament. "Behold the loss of all this wealth, this criminal waste of natural resources!" cries the statistician, until we find ourselves almost sniffling in sympathy. Amid all this *illogical agitation* (sic) for forest preservation it is well to turn an eye toward the timber of the future "concrete lumber" as it has been aptly called, etc.

Are we to understand that engineers and contractors are willing to look forward to a concrete age, which will be independent of the waste of natural resources? The statistician tells us that the production of cement in 1890 was 335,000 barrels; in 1907 it was 52,000,000 barrels, worth $56,000,000. Will some one tell us how many *tons of coal* will be required to manufacture the cement which the world will require during the present century? And then will some one go farther and estimate how many board feet of lumber are likely to be used to make the forms required for concrete construction? The organized effort which is now being made to educate the people, so that wasteful extravagance shall cease, should receive the hearty support of the engineering profession and press. The following statement of Dr. I. C. White, state geologist of West Virginia, is likely to become classic and can not be *too often* reprinted:

> **Just as sure as the sun shines and the sum of two and two is four, unless this insane riot of destruction and waste of our fuel resources which has characterized the past century shall be speedily ended, our industrial power and supremacy will, after a meteor-like existance, revert before the close of the present century to those nations**

that conserve and prize at their proper value their priceless treasures of carbon.

ALLERTON S. CUSHMAN,
Assistant Director

OFFICE OF PUBLIC ROADS,
U. S. DEPARTMENT OF AGRICULTURE

MAGNETIC ROCKS

WHILE in southern Arkansas recently, studying the northern outcrops of the oil-bearing horizons of Louisiana, I took occasion to ascertain whether the peridotite eruptives about Murfreesboro, Arkansas, were as magnetic as similar rocks in central New York. They prove to be so; hence it seems that if a somewhat detailed magnetic survey of the region thereabout were made the tens of thousands of dollars now expended in worthless options might practically all be saved. Naturally in searching for diamonds the first information desired is the whereabouts of the volcanic necks bearing the diamond dirt. Though these are covered by plateau gravel or alluvial sands and clays they can be detected as readily as the dikes in central New York can be located though under many feet of glacial till.

G. D. HARRIS,
Geologist to Louisiana

A NEW PHENOMENON IN ELECTRIC DISCHARGE

DURING last May the writer used a wire of platinum having a diameter of 0.005 cm., in some work in electric discharge around a right angle in a wire. The discharges were made non-oscillatory in character, by introducing into the circuit a couple of strips of cloth such as is used for surgical bandages. These strips, which were in multiple, connected two tumblers containing salt solution, one of which was about 20 cm. above the other.

During about three weeks of use, a system of wavelets formed along the whole length of the wire. They were very uniform in dimensions. The wave-length was 0.090 cm., and the amplitude from crest to crest was 0.015 cm. The wire was under tension of four grams weight, by means of silk threads passing over pulleys.

The writer is under the impression that the irregular bending of wires traversed by a continuous current has been observed, but is unable to find a reference to it.

FRANCIS E. NIPHER

THE DATING OF PUBLICATIONS

TO THE EDITOR OF SCIENCE: Through accident or policy, the Carnegie Institution has not dated many of its recent publications. In bibliographical citations, where dates are used to designate publications, it is difficult to dispose of papers where the time of publication is not given. Moreover, is it not desirable to date articles, to protect the writers in priority?

MAX MORSE

THE COLLEGE OF THE CITY OF NEW YORK,
February 2, 1909

SCIENTIFIC BOOKS

Die Metamorphose der Insekten. Von P. DEEGENER. Pp. 56. Leipzig u. Berlin, B. G. Teubner. 1909.

This little book, by one who has written several valuable articles on the development of the alimentary tract of insects, is one of the most thoughtful and suggestive of a number of recent general accounts of Hexapod metamorphosis. The author adopts the now usually accepted view, advanced by Fritz Müller in 1864, that the larvæ and pupæ of insects represent cœnogenetic adaptations, the result of a tendency, so to speak, on the part of an originally monomorphic form, to become strongly trimorphic during its ontogeny. In other words, the more specialized insects (Holometabola) have found it increasingly advantageous to assume three successive forms during their metembryonic development: the first, or larva, being devoted to alimentation and growth, and often exhibiting peculiar modifications to suit the highly specialized environment in which it lives, the third, or imago, being devoted to the reproduction and dissemination of the species, and the second, or pupa, providing for the transformation necessitated by the two other very different stages.

Deegener's work is divided into three parts: an analysis of the organization of the larva, a consideration of the phylogeny of metamorphosis and of the significance of the pupal stage. He recognizes three kinds of larvæ:

the *imaginiform*, which occurs in the Ametabola (Heteroptera, Orthoptera) and is very similar to the imago into which it develops, the *semimaginiform*, which occurs in the Hemimetabola (Amphibiotica, some Homoptera) and is less similar to the adult, and the *true larva* of the Holometabola (Hymenoptera, Diptera, Coleoptera, Lepidoptera, etc.), which is succeeded by a quiescent pupal stage. The organs of the various larvæ are considered under the following heads:

1. Larval organs that are simpler than those of the imago but of nearly the same structure, or such as are absent in the imago but are nevertheless of a primitive character, as shown by comparison with their homologues in lower insects. Examples of such organs are the mouth-parts and antennæ of ephemerid larvæ, the cerci of campodeiform larvæ, non-pentameric tarsi, etc.

2. Organs that are more or less atrophied or vestigial in both larva and imago, *e. g.*, the labium and maxillæ of *Corethra* and *Chironomus*, the larval eyes of *Corethra*, etc.

3. Organs that were first acquired by the imago but subsequently transmitted to the larva, or that have taken on the imaginal form secondarily in the larva, like the sucking mouth-parts of the Hemiptera. To this category Deegener also assigns organs which appear in the larva as primordia of imaginal structures. These he calls *secondary imaginal discs*, in contradistinction to the *primary imaginal discs* which are represented by such structures as the wing-pads of the imaginiform and semimaginiform larvæ.

4. Organs that have been acquired by the larva independently of the imago and are either completely lacking in the latter (pedes spurii, sericteries) or have been acquired by it secondarily (external gills of some Perlids, rectal gills of Odonata, etc.). Such structures are designated as *provisional organs of the first order*.

5. Organs common to both larva and imago but developing in different directions in the two instars (sucking mandibles of the larval *Hemerobius*, *Chrysopa* and *Dytiscus*; digging legs of *Cicada* larvæ). Such structures are called *provisional organs of the second order*.

6. Organs that are typical or primitive portions of the insect organization but are completely retarded in their development during larval life and remain as primordia, or imaginal discs. These are called *tertiary imaginal discs* to distinguish them from the primary and secondary imaginal discs mentioned under (3). The gonads and their ducts, especially the latter, may be included under this sixth category, but in one sense they form a category by themselves, as they are not specifically insect organs and as the gonads sometimes mature during larval or pupal life.

Deegener calls attention to the fact that none of the organs of the imago is actually lacking in the larva, but that the latter may possess organs which do not occur in the imago. He concludes from this that the true larva "must be derived from the imago and hence presupposes the existence of the imago, and that therefore this is phylogenetically older than the larva, but that the true larva is younger phylogenetically than the imaginiform young of the Epimorpha and semimaginiform young of the Hemimetabola." This conclusion and Deegener's classification of larval characters would appear in a somewhat clearer light had he not neglected to take the embryo into consideration. A single example will make this statement clear. It is well known that certain embryonic organs, such as the thoracic appendages and antennæ, are lacking, as appendages, in the vermiform, or apod larvæ of many Hymenoptera, Diptera and Coleoptera, but are present again in the imago. This fact alone proves that the vermiform larva is an extreme cœnogenetic adaptation. It also throws light on another matter which Deegener, Heymons, Berlese and a host of other writers seem not to have clearly grasped, namely, the significance of the relations of the abdominal appendages of the embryo insect to the so-called prolegs (pedes spurii) of the larva. Deegener says of these:

> I assume that the pedes spurii do not arise *directly* by transformation from the appendages of polypod ancestors, and hence that they are not phylogenetic recapitulations (any more than are the tracheal gills) but are to be regarded as new

formations, which, however, have not originated independently of the vestiges of the abdominal appendages. The looseness of this dependence, however, is shown in certain Noctuid caterpillars, in which some of the pairs of prolegs make their appearance during larval life and hence at a time when the abdominal appendages have completely disappeared. I can not, therefore, regard the pedes spurii as primary, or even as resuscitated organs, but only as secondarily adapted provisional organs.

This statement if applied to the ontogeny would involve the unwarrantable assumption that the abdominal legs of the embryo disappear in the larva. This they do in many cases as hollow ectodermal evaginations filled with mesoderm, but they persist, nevertheless, as small, flat cellular areas in the ectoderm. In other cases, there is abundant evidence to show that they are directly transformed into the prolegs of the larva (Lepidoptera) and the gonapophyses of the larva or imago (Orthoptera). Where they are not thus transformed directly, but first flatten out, we obviously have the primordia of imaginal discs, and the organs would belong to Deegener's sixth category. Reverting now to the absence of antennæ and thoracic appendages in apod larvæ and their presence in the preceding or embryonic and the succeeding or imaginal instars, we see that we have a case of precisely the same nature as that of the abdominal appendages, though clearer on account of the larger size of the cephalic and thoracic structures and their imaginal discs. But any such ontogenetic conclusion as Deegener draws from the abdominal appendages of the Noctuid larvæ would here land us in the absurdity of supposing that the imaginal antennæ and thoracic legs of such insects as bees, weevils and ants are not completely homologous with their embryonic antennæ and thoracic legs. We are bound to conclude that all insect embryos are polypod and that the most ancient known Pterygogenea, the Palæodictyoptera, as Handlirsch has shown, had well-developed abdominal appendages, which must have been ambulatory in the more remote ancestors. It is, therefore, simpler to suppose, even if embryology did not furnish a great amount of evidence in support of this conclusion, that the ambulatory function has been revived in some of these appendages (pedes spurii of the caterpillars of Tenthredinidæ, Lepidoptera and Panorpatæ, pedes scansorii of Dipteran and Coleopteran larvæ), while others have become portions of the ovipositor and sting of the female insects, than to suppose that these various organs have come into existence *de novo* through modification of abdominal sclerites. This view, which is now fashionable in Germany, has arisen through ignoring or misinterpreting the conditions in the insect embryo, attaching undue importance to supposed homologies of the sclerites of adult insects and supposing that the organization of the Pterygogenea is to be interpreted by means of the Thysanura. It is a pleasure to see that Deegener departs from the conventional view to the extent of regarding the so-called campodeiform larva in the Holometabola as a secondary and not as a primitive type. In this respect his views coincide with those of Lameere, Boas and Handlirsch.

All entomologists will probably agree with Deegener that the characters peculiar to the larva have "arisen during metembryonic life successively in adaptation to differences in the conditions of the environment." He discusses at some length the reasons for the larval retardation in the development of the wings, and in this connection gives an interesting account of the subimago of the Ephemeridea, for the purpose of showing that an insect can actually undergo ecdysis after it has completely or almost completely developed its wings, but he does not emphasize the obvious fact that the wings of insects are organs primarily associated with the dissemination of the species, and, therefore, correlated ontogenetically with the maturation of the reproductive organs. The few larvæ that are pædogenetic (*Cecidomyia*) and the few beetles (*Pissodes*, Scolytidæ) that become imagines long before reproduction, though striking exceptions, can readily be explained as secondary adaptations. Attention is called to the reduction of the number of ecdyses and the manner in which pupation has become

associated with two of these in metabolic insects. The pupa of the Holometabola is regarded as being to a certain extent a phylogenetic stage, analogous to the subimago of the Ephemeridea, but as having developed its peculiarities (quiescence, unchanged external form and profound internal changes) in correlation with the structural differences that separate the larva from the imago. These differences are described as follows:

In the Hemimetabola the whole development appears as at first progressively imaginipetal (total habitus), later as temporarily and progressively imaginifugal (provisional organs), with ontogenetic adaptations, and finally as regressively imaginipetal (involution of the provisional organs). In the Holometabola, on the contrary, development is at first regressively imaginifugal (total habitus and imaginal organs), then progressively imaginifugal (development of provisional organs of first and second order) and finally (in the pupa) progressively (total habitus and imaginal discs) and regressively imaginipetal (involution of provisional organs). Hence the Holometabola are characterized in the metembryonic portion of their life cycle by a regressively imaginifugal type of development, which changes to the progressively imaginipetal type in the pupa. In other words: Whereas the continuously progressive development of the Hemimetabola is not interrupted and is only slightly affected by the formation of provisional organs, the progressive development of the Holometabola up to the imaginal stage suffers a long interruption (during the larval stage) and is not resumed till the transition to the first imaginal stage (the pupa), in order to attain, by passing through this, the definitive imaginal form.

Deegener, like many other students of insect metamorphosis, regards the pupa as a teleological development which enables the organism greatly to lengthen its larval life, and through the magnitude and intensity of the changes which it undergoes, to drop out or fail to recapitulate, a great number of phylogenetic stages and thus to pass directly into the adult condition. The development of such a pupal stage, he believes, has been facilitated by the ability, so frequently observed in insects, to fast for long periods of time. In this connection he might also have called attention to the adaptation of the pupal stage to tiding over unfavorable seasons (cold winters in temperate and boreal, dry seasons in tropical regions), as has been pointed out by Lubbock, Haacke, Handlirsch and others.

WILLIAM MORTON WHEELER

The Systematic Relationships of the Coccaceæ, with a Discussion of the Principles of Bacterial Classification. By CHARLES-EDWARD AMORY WINSLOW and ANNE ROGERS WINSLOW. New York, John Wiley & Sons. 1908.

The book before us is the completed results of work by these authors of which we have had preliminary information through articles in SCIENCE[1] and the *Journal of Infectious Diseases.*[2]

This work is by far the most important contribution to the purely scientific side of bacteriology which has appeared in a long time. It marks the beginning of a new era in bacteriological classification and nomenclature.

The systematic classification of the bacteria has always been extremely artificial and arbitrary. Outside of the three large morphological groups, the cocci, bacilli and spirilla, classification has probably never expressed natural relationships. However useful for purposes of identifying species artificial classification may be, it never reaches its highest function until it tells us more than whether a species has been previously described in the literature. It can never be really useful until it expresses for us the real position of the species in question in relation to other forms, and to some extent, at least, tells us the probable line of descent which the species has followed in its development from other forms. This is the ultimate goal which the classification of all living forms should seek.

A few attempts have been made to recognize certain "groups" among the bacteria, and undoubtedly some of these groups repre-

[1] "A Revision of the Coccaceæ," SCIENCE, N. S., XXI., 1905, 669.

[2] "A Statistical Study of Generic Characters in the Coccaceæ," Biological Studies by the Pupils of William Thompson Sedgwick, Boston, 1906; also *Journal of Infectious Diseases*, III., 1906, 485.

sent natural families or genera. Some of these groups are based on morphological distinctions while others are simply held together by certain physiological resemblances. And in practically all cases as soon as the firm ground of morphological characters is left, and attempts are made to make use of physiological differences, we find systematic bacteriology becoming simply determinative bacteriology, and all semblance of natural relationships is lost in a confusion most bewildering.

It has remained for the work of the Winslows to bring order out of chaos, to show us how it is possible to delimit the different groups of bacteria and to determine their natural relationships, with just as sure a footing, whether we make use of morphological or physiological characters.

Their method of defining bacterial groups is by a study of the numerical frequency of various characters in a large series of cultures. It matters not whether the characters are morphological or physiological as long as they are measurable. It is true this method of defining species is not original with these authors; anthropologists and students of variation and heredity have developed it for the study of their particular facts. Even among bacteriologists it was being used at the same time that the work of the Winslows was going on by Andrewes and Horder in England for the classification of the streptococci. But it was our present authors who pointed out the importance of this method for work with the bacteria, and it is to them that all credit should be given for working out the method and applying it on a large scale to the problem of bacterial classification.

It is not necessary here to refer to the method of biometry. It depends on the fact that fluctuating variations, when measured in a considerable number of individuals, group themselves in a curve which follows the simple mathematical law of chance. If two large arrays of individuals are measured the curves obtained are practically identical. But if arrays from different origins are measured the shape of the curves will differ, as well as the position and height of the modes. Such curves measure the peculiarities of a group as a whole, and serve to discriminate the different types, even though particular members of the groups are indistinguishable. By extending the observations to include the correlation of characters in the different racial types, the statistical method will indicate the systematic relationship of the different types.

As the authors themselves say:

> The biometric methods, which have proved so useful in the study of the races of man, promise to be of even greater value in the systematic analysis of types among the bacteria, where so many factors combine to preserve varietal differences on so wide a scale. If individual strains only are considered, an infinite series of differences appear. If the same strains are considered statistically, that is, if the frequency of a given character be taken into account, it is apparent that certain combinations of characters are much more common than others. Measurement of almost any character by quantitative methods shows that the bacteria examined group themselves on a simple or complex curve of frequency. The modes of this curve indicate centers of variation about which the individuals fluctuate; and these centers of variation are the real systematic units of the group. The recognition of such centers, as specific types, offers the natural and satisfactory compromise between systematic multiplicity and vague generalization. The grouping of specific types is an even more important problem than the definition of the types themselves; and here the correlation data obtained by biometric study are of assistance. A true natural classification is treelike and includes branches and twigs of varying grades of importance. Genera of bacteria should be aggregates of those specific types which are most nearly related; and the basis of the relationship will differ in each individual case. . . . Finally, the results may be analyzed with two ends in view. First, each center of numerical frequency, marking a group of organisms varying about a distinct type in regard to a single definite property, may be recognized as a species. Second, those species which are bound together by the possession of a number of similar properties may be constituted as genera, and larger groups of genera, still characterized by some characters in common, may receive the rank of families or subfamilies.

The recognition of these principles will throw a flood of light upon all our future at-

tempts to classify the bacteria. It will give us a sound foundation upon which to build our systematic groups. It will give us a simple and natural nomenclature in place of the unwieldy generic names in use at present, and will do away with the tendency so noticeable now to use trinomial or even quadrinomial names.

Besides pointing out the proper way to work out the classification of the bacteria the authors have set us an example of just how to go about the work by their careful study of the Coccaceæ. They collected 500 different strains of cocci from different sources and submitted each one to a series of eleven definite, and in most cases, quantitative tests. The frequency curve for each character was plotted, the modes determined, and these modes were taken as the bases for the establishment of the various groups. The eleven characters were chosen after due deliberation and while there may be a difference of opinion as to the relative value of these characters and others which might have been selected, yet we must agree with the authors when they say that the eleven tests chosen furnished sufficient information to warrant the recognition of the most important natural groups. A further study of the correlation of these characters seems to point to the fact that these systematic units are marked by the general association of a number of independent characteristics. Such an association can be explained, our authors say, only on the ground of relationship, therefore the classification which they have arrived at is a natural one, and one which meets the requirements of expressing the natural relationships of the different groups.

The authors find eight genera among the Coccaceæ, each of which they define and discuss. To the bacteriologist familiar with the earlier classifications some very striking and totally unexpected results appear. First of these is the importance of pigment production as brought out by this method. Hitherto it has been taken for granted that such an easily modifiable character as the production of pigment was scarcely even of varietal rank. But a study of chromogenesis by the biometrical method shows that the production of the various pigments is the property of certain well-defined types, and when we take into consideration the singularly perfect correlation between this property and the fermentation of the sugars, and with other characters, we must agree with the authors that it is really of genetic significance. Second, we find that the authors lay little stress on such characters as the shape and markings of colonies on gelatin or agar, the shape of the liquefaction in the gelatin stab, the luster or surface appearance of agar streaks, characters which we have been in the habit of considering important. They show that for the most part these characters are but the result of differences in general vigor of growth and in the rate of liquefaction of the gelatin. They summon sufficient evidence to support their position so that we are forced to agree with them. But they are careful to state that their conclusions apply only to the Coccaceæ and that some of these characters may be found important when other groups are studied.

The book closes with a summary of the genera and species of the Coccaceæ, an admirable key to these genera and species, and finally a complete bibliography and author and subject indexes.

While the work on the Coccaceæ is most admirably done and gives us a working basis for all future study of these forms, yet its real worth is not in its own intrinsic value, but in its immense suggestiveness for all future work in the classification of other groups of bacteria. We hope that this will be but the first of a long series of monographs dealing with other groups of the bacteria, all worked out along the lines which these authors have so well marked out for us.

F. P. GORHAM

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A Treatise on Gold and Silver. By WALTER R. CRANE, Ph.D. New York, John Wiley & Sons. 1908.

The preface states that "The object of this work with others of a series is to give a complete and accurate record of the development

of the mineral resources of the country and its influence on the various industrial activities throughout the United States," and that it "has been prepared with aid received from the Carnegie Institution of Washington, and is to form part of the Economic History of the United States, which is to be published by that Institution. . . . The work has been conducted under the supervision of Mr. Edward W. Parker" and its preparation "has occupied two years," etc., from January, 1906, to January, 1908.

Perhaps the value of such a contribution is enhanced by its character as a compilation, and this may give some excuse for the repetition of details under different heads. But the very semblance of statistical quality emphasizes the advantages which might have accrued from the presence of an adequate index or an expanded system of paragraphing. So very much of laboriously collected material has been itemized in the 720 pages, that thousands of entries would be necessary to properly catalogue them. This work has but 500 references in the index, and these are mostly equivalent to the titles of broad divisions of the text. There are typographical errors in proper names of the west, some displeasing errors in grammar and rhetoric and other literary blemishes, but these can all be corrected in later editions and are much less conspicuous than would be the case but for the heavy proportion of quotations, in which these defects do not appear.

There are seven chapters, covering various aspects of gold and silver. The first deals in a semi-philosophical way with precious metal mining as "a factor in the industrial growth of the United States," crediting this industry very largely with the development of civilizing influences, by the inception of agriculture, extension of transportation facilities, expansion of finance, stimulation of scientific enterprises, the upbuilding of mining schools and the general development of the mining industry.

The history of the discovery and growth of precious metal mining and metallurgy is then given in great detail, by geographic divisions, followed by a full chronologic treatment, covering the period from 1513 to 1906.

This portion of the work bears evidence of painstaking library research, and probably the results are, all considered, as satisfactory as could have been anticipated by this method alone. It is cause for regret that an institution of the prestige of the Carnegie should not have availed itself of the services of reviewers in all parts of the country in order to preserve an even balance throughout the record. It is no disparagement to the able young author to suggest this; for he has performed uncommonly well an arduous task, in assorting his material and condensing it as he has done. The general impress is correct, remarkably so, indeed. Very few false conclusions are expressed, although some errors are apparent, which need not here be specified.

Chapter III. treats of "Occurrence and Association of Gold and Silver." It opens with a professedly cursory review of current theories of ore deposition, which is a model of perspicuity and a striking example of self-restraint in the presentation of the current aspect of a much-involved series of problems. The summary of it all is the quotation from A. G. Lock, which puts the case in a nutshell.

Following is a general discussion of the variety of mineral occurrences, ending with a review of prejudiced notions and their injurious effects upon the mining industry.

Then come 120 pages of detailed descriptions of occurrence, arranged alphabetically by states. This chapter gathers a vast array of facts, wholly unclassified and largely repetitive, but often useful in this form. There has been here no attempt to arrange this material more specifically, or to trace connection between the minor areas. Many more pages are taken up with the occurrence, geographically, of gold in gravels.

Only ten pages (chapter IV.) are given to the geologic distribution of gold and silver, and this deficit must be regarded as a blemish. It is true that the presentation in this concise manner bears abundant evidence of the author's thorough acquaintance with the subject

and of his ability to condense. But some might prefer the relegation of the prolix chapters which precede, to a separate volume, giving opportunity for more adequate treatment of subjects which appear to be slighted over much.

Chapter V. has 130 pages devoted to Mining Gold and Silver Ores and Gravels. This is well put together and presents a very fair outline of methods of mining, being very largely a series of quotations from leading authorities, although in some parts the author exhibits his own qualifications by presenting well-digested material in his own words.

In chapter VI. a similar arrangement of authoritative quotations, edited and connected by appropriate remarks, makes a generalized review of about 80 pages.

Nearly 100 pages (as chapter VII.) are given to statistics of production, compiled by geographic areas, as usual. This work has been well performed. Six appendices follow in the form of tables, recapitulating in detail the statistical matter previously given, under practically equivalent headings. These crowd a vast amount of particular information into little more than 60 pages, but they are by no means as complete as they might have been made by seeking the aid of many local colaborers. As a convenient hand-book for ready reference by busy practitioners, the statistics and much of the technical matter quoted may be in useful form, and probably the whole will fill a want among the untutored who require pre-digested nutriment. The abundant references, though lacking the personal factor which would ordinarily attest their authority, add greatly to the value of the work.

The compiler has rendered good service faithfully and conscientiously, according to a plan apparently dictated by others. Perhaps it is premature to express any opinion upon certain features which might be otherwise rated if one really knew the purpose of the Carnegie Institution in having prepared the series of texts of which ostensibly this is the forerunner. For instance, under the head of Extraction of Values, no mention is made of the flux smelting of gold and silver ores, concentrated in lead and copper menstrua. Although it is probable that this has been reserved for future volumes of the series, where the discussion may be more appropriate, there appears throughout the present volume a tendency to minimize the importance of the fact that the actual weight of silver annually extracted from placers and dry ores amounts to nearly four and one half times the weight of gold obtained from the same source. This is not an economic argument, to be sure, in favor of more generous treatment of the minor metal in a work purporting to deal with both. But the facts are that the weight of all silver extracted amounts to about fourteen times the weight of the gold, and that much more than three fourths of the total silver product (equal in value to one third of the gold product) is won by metallurgic processes designed primarily for the recovery of the silver. Moreover, the metallurgy of the baser ores, *per se*, is in many respects so distinctive that the collection of gold and silver therein is to be regarded properly as a separate industry. That is to say, the presence of the precious metals in ores limits and defines processes of treatment in such a manner as to make the grosser metals the real by-products.

Therefore, it would seem logical and profitable to discuss some methods to which little or no reference has been made in Dr. Crane's work.

Keeping always in mind the introductory words of this review, if it be fair to judge by them alone, the author appears to have compassed very well the task set by the Carnegie Institution. Probably no one else was better placed to perform this identical service by the means employed in executing it. One might prefer a different mode of treatment and the enlistment of others in the collaboration of data not readily accessible in print. But criticisms of this kind must not be permitted to obscure the patent fact that the writer appears to the very best advantage in those parts in which his subjects have given him more free scope for the exercise of his own abilities, and where dictates of modesty and

honor have not appeared to make rigid quotation essential. THEO. B. COMSTOCK

LOS ANGELES, CAL.,
January 15, 1909.

Ueber das Wesen der Mathematik. Rede gehalten am 11 Marz, 1908, in der öffentlichen Sitzung der k. Bayerischen Akademie der Wissenschaften. Von Dr. A. Voss, Professor der Mathematik in München. Pp. 98. Leipzig und Berlin, B. G. Teubner. 1908.

The numerous and valuable earlier publications of the author of the present address inspire confidence in his ability to treat such a general subject in a scholarly and helpful manner. The reader will find that this confidence has not been misplaced, for the address is not only replete with important suggestions in regard to fundamental questions in mathematics, but it also emphasizes those elements which point towards rapid progress in the near future and thus awaken a healthy optimism. It seems especially suited to widen the outlook and to arouse energizing enthusiasm on the part of the young mathematician who may fail to appreciate the dignity and the beauty of abstract thought.

The author begins his address by the statement that we are living in the epoch of natural sciences and technology, and he quotes approvingly the remarks of Galileo:

> True philosophy explains nature, but no one can understand her except those who have learnt the language and the symbols by means of which she speaks. This language is mathematics and the symbols are mathematical figures.

The bearing of mathematics just mentioned tends to explain why this subject is constantly taking deeper root in the educational systems of the world, notwithstanding the fact that it is "the most unpopular of all the sciences; it is a part of the essence of a true science to be unpopular."

The brief introductory remarks are followed by a rapid sketch of some fundamental facts in the history of mathematics. Beginning with the Egyptian work, written by Ahmes nearly four thousand years ago, which claims to give "Directions to obtain a knowledge of all dark things, all secrets contained in the things," our author considers the historical development of a number of fundamental mathematical concepts and symbols. He generally follows the "Prince of mathematical historians," Moritz Cantor. In one instance, however, he adopts a view which is not in accord with the most recent work of Cantor, viz., as regards the question of the origin of zero and the positional arithmetic. Ten years ago it was generally believed that these discoveries were due to the Hindus, while the most recent work of Cantor makes a Babylonian origin appear much more plausible.

As may be inferred from the heading of the address, emphasis is placed upon those mathematical concepts which border on the domain of philosophy. Among the questions which receive considerable attention are the following: definitions of mathematics, relations between mathematic and logic, the development of the concept of number, higher complex number systems and different points of view as regards ordinary complex numbers, different theories in regard to ordinary fractions and irrational numbers, continuity and limit, importance of the concept of function, and suggestions as to changes in the subject-matter to be used for instruction in secondary schools. The address is written in a popular style and should interest the man of general culture as well as the professional mathematician.

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SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Experimental Zoology, Vol. VI., No. 1 (January, 1909), contains the following papers: "A Study of Growth in the Salamander, *Diemictylus viridescens*," by Ada Springer. "Studies on Chromosomes—IV., The Accessory Chromosome in *Syromastes* and *Pyrrochoris*, with a Comparative Review of the Types of Sexual Differences of the Chromosomes," by Edmund B. Wilson. This paper is devoted to a reexamination of two forms heretofore studied by Gross. It shows that sex-production in these forms agrees in principle with that seen in other insects. In *Pyrrochoris* the spermatogonial number is 23

and a typical odd chromosome is present. In *Syromastes* the spermatogonial number is 22, the "accessory" being represented by two chromosomes, and the number 24 is inferred for the female. A general review is given of the facts thus far determined in this field. N. M. Stevens contributes "Further Studies on the Chromosomes of the Coleoptera" and "An Unpaired Heterochromosome in the Aphids." David Day Whitney writes on "The Effect of a Centrifugal Force upon the Development and Sex of Parthenogenetic Eggs of *Hydatina senta*." The unsegmented eggs were centrifuged so that their contents were separated into three layers. These layers were variously arranged in their relation to the first cleavage plane and consequently a different distribution of the egg material occurred in each of the cells at the first cleavage. From such eggs normal individuals developed, grew to maturity, and produced normal offspring. No change in the sex ratio occurred. The same author has an article on "Observations on the Maturation Stages of the Parthenogenetic and Sexual Eggs of *Hydatina senta*." In the female parthenogenetic egg there is no reduction in the number of chromosomes during maturation but in the male parthenogenetic egg and also in the fertilized egg there is a reduction in the number of chromosomes. One polar body is formed by the female parthenogenetic egg and two polar bodies are formed by the male parthenogenetic egg.

A NEW VARIETY OF ASYMMETRY EXHIBITED BY THE NITROGEN ATOM

A NUMBER of organic compounds are known the isomerism of which is due to the different spatial arrangement of certain groups around a nitrogen atom. The most familiar examples are the oxines, such as benzaldoxine, which exists in the forms,

$$\begin{array}{c} C_6H_5CH \\ NOH \end{array} \quad \text{and} \quad \begin{array}{c} C_6H_5CH, \\ HON \end{array}$$

termed the *syn-* and *anti-* modifications, respectively.

A second variety of isomerism is recognized which is dependent on the fact that the nitrogen atom is linked to five dissimilar groups, as, for example, in the compound,

$$\begin{array}{c} CH_3 \\ C_2H_5 \end{array} > \overset{Cl}{N} < \begin{array}{c} C_6H_5 \\ CH_2C_6H_5 \end{array},$$

which exists in three forms. One is optically inactive (racemic) and the other two rotate the plane of polarized light to the right and left, respectively.

Similar varieties of isomerism are, of course, common in the case of analogous carbon compounds free from nitrogen.

Hitherto it has been believed that the difference in optical behavior mentioned above could not be exhibited unless all five of the groups linked to the nitrogen were unlike, but J. Meisenheimer[1] has just shown that this is not the case.

When methylethylaniline,

$$C_6H_5N < \begin{array}{c} CH_3 \\ C_2H_5 \end{array},$$

is treated with hydrogen peroxide, in presence of sulphuric acid, methylethylaniline oxide,

$$\begin{array}{c} CH_3 \\ C_6H_5 \end{array} > N < \begin{array}{c} C_2H_5 \\ \| O \end{array},$$

is formed. It is a crystalline, basic substance and is optically inactive. By the fractional crystallization of its *d*-bromcamphorsulphonic salt it is separated into two modifications. From these the corresponding free bases may be isolated and other salts prepared. These free bases are relatively stable and they rotate the polarized light to the right and left, respectively, the rotation being equal in degree.

It is, at present, uncertain whether these optically active free bases have the anhydro formula given above, with the double linkage between nitrogen and oxygen, or whether they are dihydroxides,

$$\begin{array}{c} CH_3 \\ C_6H_5 \end{array} > N \begin{array}{l} < C_2H_5 \\ - OH \\ \backslash OH \end{array}.$$

In either case, however, the isomerism is of an entirely new type. It will be interesting to see whether it is possible to prepare analo-

[1] *Ber. deut. Chem. Ges.*, 41, 3966, 1908.

gous compounds of the carbon series, free from nitrogen.

J. BISHOP TINGLE

MCMASTER UNIVERSITY,
TORONTO, CANADA,
December 16, 1908

RUSSIAN RESEARCH IN METABOLISM

THE activity of Russian investigators in problems of animal nutrition and metabolism in general has been but imperfectly noted by the large majority of workers in metabolism. This is in large part due to the fact that in spite of increasing interest in international cooperation in scientific research in all branches, the Russian language remains, and probably will continue to remain, a distinctly unintelligible vehicle for conveying scientific communications to the world at large. More recently at least one Russian journal is issuing simultaneously an edition in French.

Recognizing the great importance of many of the earlier Russian researches, the Office of Experiment Stations of the U. S. Department of Agriculture has from time to time had translated and published abstracts of much of the Russian research in that particular branch of science dealing with metabolism. These abstracts were translated in large part by Professor Peter Fireman, formerly of the George Washington University, and the admirable digest of metabolism experiments by Atwater and Langworthy[1] contains many of them.

A dissertation entitled "Production of Heat by Healthy Man in the Condition of Comparative Rest," by A. Likhachev, is especially valuable as giving a complete description and tests of the Pashutin respiration calorimeter. This was translated at the instance of the Office of Experiment Stations, U. S. Department of Agriculture, by Dr. Fireman. Copies of the translation are on file at the Nutrition Laboratory and also at the Office of Experiment Stations, U. S. Department of Agriculture.

In connection with the preparation for publication of the results of a series of experiments on fasting men made at Wesleyan University, I arranged with a young Russian school teacher, H. Levin, to translate completely a lengthy article entitled "Metabolism during Fasting," by A. Sadovyen. This article is of interest in that it describes a series of experiments on a fasting man in the Pashutin respiration chamber. The translation is preserved in the reading room of this laboratory.

On a recent visit to a number of European laboratories it was my good fortune to include several of the laboratories in St. Petersburg, and there I came into intimate contact with a great deal of research which was to me wholly unknown. I found that in certain instances the briefest kind of an abstract had been noted in some of the German abstract journals, but nothing approximating an adequate digest of this work had appeared as yet in anything but Russian. Thanks to the kindness of Professors Likhachev and Avroroff and Dr. Kartaschefsky, many important monographs were placed in my hands and, on my return to America, arrangements were made for their translation.

Professor Likhachev sent to the Nutrition Laboratory a copy of Pashutin's treatise on experimental pathology. This large work, consisting of two bulky volumes, contains a great deal of new, unpublished material, particularly in the section (some 800 pages) dealing with inanition. During the past year the whole section on inanition has been completely translated by Michel Groosenberg. This valuable work contains a large amount of original material, chiefly from Albitsky's laboratory, and is of importance to all workers in animal or human nutrition. The translation has been typewritten, manifolded and bound and copies of this translation are deposited in the surgeon general's library in Washington, the New York Public Library, and in the John Crerar Library in Chicago. Two other monographs presenting the results of experiments on man in the Pashutin respiration calorimeter are "The Influence of Alcohol on the Heat and Gas Exchange in

[1] Bulletin 45, Office of Experiment Stations, U. S. Department of Agriculture, 1898.

Man" and "Investigations of Gas and Heat Exchange in Fevers," both by A. Likhachev and P. Avroroff. Finally, two articles by Dr. Kartaschefsky reporting experiments with the small Pashutin respiration apparatus have been translated. They are entitled "The Influence of a Lack of Oxygen on the Exchange of Matter and the Heat Production in Animals" and "On the Influence of the Surrounding Temperature upon Animals in a Gas-Atmosphere poor in Oxygen."

These articles were translated in part by Mr. Alexander Rose, of Boston, Mr. Michel Groosenberg and Miss Anna Monossowitch, who is at present engaged in Russian translation at the Nutrition Laboratory.

Thus it is hoped to keep American workers in nutrition in more intimate contact with the admirable Russian researches that have as yet been practically inaccessible. Arrangements have been made with Professor Likhachev whereby all articles dealing with problems of metabolism can be sent to this laboratory for translation. From time to time the titles and short abstracts of these articles will be published in some scientific journal.

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SPECIAL ARTICLES

A MENDELIAN VIEW OF SEX-HEREDITY

Two important contributions have recently been made to the discussion of sex-inheritance. In each a somewhat different view is presented, yet the two, I believe, are not irreconcilable, and if coordinated, will give us a truer conception of the whole matter than we have had before. I refer, on the one hand, to the recent vice-presidential address of Professor Wilson,[1] and, on the other, to the combined work of Bateson, Punnett, Doncaster, Durham and Marryat, published in Report IV. to the Evolution Committee of the Royal Society.

In 1903[2] I advocated the view that sex is inherited as a Mendelian character. The idea was not original with me. The suggestion came from the now famous Report I. of Bateson and Saunders. The fact has since come to light through Mendel's posthumously published letters[3] that Mendel himself had been impressed by the parallelism between the phenomena of sex-inheritance and those of ordinary Mendelian inheritance. Indeed, the parallelism is so complete and striking that we can scarcely question the existence of a like basis for the two sets of phenomena.

Professor Wilson, to be sure, argues against what he terms "Mendelian theories" of sex-heredity and advances a somewhat different theory of his own. In reality, however, his theory, while an improvement upon its predecessors, is no less Mendelian than they, but rather more so, as I shall attempt to show.

Great advance has been made since 1903 in our knowledge of Mendelian inheritance in general, as well as of sex-inheritance, and it is noteworthy that in restating our knowledge in the two fields similar changes must be made in both. For example, we formerly said regarding crosses between rodents of different colors that "gray is dominant over black" and that "black is dominant over yellow," meaning that the contrasted characteristics were antagonistic and one excluded the other in crosses. As we now look at the matter, gray is not antagonistic to black, but contains an additional element which is wanting in black. The correctness of this view is shown by the fact that black can be changed to gray by a cross which introduces that additional element. A similar relation holds between black and yellow; black is yellow plus something else, and this something else may actually be added to yellow (by a cross with brown, for example) converting it into black.

Similarly as regards sex, in 1903 I expressed the view that male and female are antagonistic members of a Mendelian pair, one excluding the other. Such a view is inadmissible in the light of our present knowledge. What we should say is that the female is the male condition plus something else. Male-

[1] SCIENCE, January 8, 1909.

[2] *Bulletin, Mus. Com. Zool.*, Vol. 40, p. 189.

[3] *Abh. math.-phys. Klasse d. k. Sachs. Gesellsch. d. Wiss.*, Bd. 29, p. 185, Leipzig, 1905.

ness is not, then, the Mendelian allelomorph to femaleness, but a differential factor between male and female is allelomorphic to absence of that factor. Presence of that factor means femaleness, absence of it means maleness. This differential factor is inherited as a Mendelian character dominant over its absence.

Such a statement will, I believe, bring into harmony the seemingly discordant results of Wilson, of Correns, and of Bateson and his associates. For Correns urges the view, as I did in 1903, that the male and female sex-characters as such are inherited. He believes further that the female organism is a homozygous recessive (♀♀) and the male a heterozygous dominant (♂♀), for he finds that the egg-cells of *Bryonia dioica* all transmit a female sex-tendency, whereas the pollen cells transmit, half of them the female tendency, half the male tendency. His facts are unquestionable. I question only the supposed recessive nature of the female sex-character.

Wilson cautions us against the view that sex as such is inherited, believing that the difference between the two sexes is in reality a quantitative one. He finds the female characterized by the possession of two X-chromosomes, the male by one, and regards a second x-chromosome as the differential factor between male and female. In the view that the essential difference between the sexes is a quantitative one, Wilson makes general an assumption made earlier by Morgan[4] for a particular case.

This suggestion seems to me very helpful. Among other things, it clears up fully the long mysterious matter of sex-determination in the honey bee, of which I gave in 1903 an interpretation since proved to be wrong. But though we regard the distinction between male and female as quantitative, we must not forget that it is discontinuous. *The female is the male condition plus a distinct unit-character Mendelian in heredity.*

We must also not follow Professor Wilson too closely in his assumption "that a single X-element in itself causes or determines the male tendency, while two such elements in association create, or at least set free, the female tendency." For we shall presently see reasons for believing that in certain cases *one* X-element may determine the female tendency, while *no* X-element may determine the male tendency. But in both categories of cases alike the essential difference between male and female would seem to be one X-element, which the female possesses over and above the male.

We may leave open the question whether or not the "X-element" of Wilson is the actual material basis of this differential Mendelian unit-character of sex. The X-element at least behaves in cell-division as we must suppose that the basis of a Mendelian character would behave, and it will be convenient in what follows to treat it as actually representing such a basis.

Wilson's hypothesis will account satisfactorily for the experimental results of Correns, for it necessitates the production in gametogenesis of eggs all alike in sexual tendency, bearing X, but it calls for the production of spermatozoa of two different sorts, half of them bearing X, half of them without X. Eggs fertilized by the former should produce females (XX), those fertilized by the latter should produce males (X). Correns's observations accord with this interpretation.

But the Wilson hypothesis breaks down if we attempt to extend it to the cases discovered by Bateson and his associates. For in these it is evident that the eggs, not the spermatozoa, are dimorphic in sex tendency, whereas the spermatozoa are all alike. We can not reconcile such a condition with the hypothesis that XX produces a female, X a male. But the condition in question does harmonize with the assumption, X = a female, no-X = a male, and this condition, no less than that described by Correns for Bryonia, agrees with the more general assumption that the female possesses one more X-element than the male.

The cases to which reference has been made in which the female produces eggs with different sex-tendencies, but spermatozoa all with

[4] SCIENCE, Vol. 21, 1905; *Am. Naturalist*, Vol. 41, p. 715, November, 1907.

the same sex-tendency, are, first, the moth, *Abraxas grossulariata*, and, secondly, the canary-bird. The two cases appear to be similar, but as the former has been more fully worked out, we may confine our attention to that. The case of *Abraxas* has already been presented in part to the readers of SCIENCE by Bateson and Punnett.[8]

This moth has a rare variety, *lacticolor*, known originally only in the female sex. For brevity in description we may call the typical *grossulariata* condition G, and the *lacticolor* condition L. The latter is a Mendelian recessive to the former.

Cross 1.—The cross L♀ × G♂ gives only G offspring in both sexes, but of course all bearing L as a recessive character. See Table I.

Cross 2.—Heterozygotes (produced by cross 1), when bred inter se, produce G♀, G♂ and L♀, but in no case L♂ offspring.

Cross 3.—A heterozygote G♂, mated with L♀, produces all four possible combinations, G♀, G♂, L♀ and L♂. "The L♂s thus produced were the first that had ever been seen." Now comes the most remarkable part of the whole story.

Cross 4.—When the newly produced L♂s were mated either with heterozygous G♀s produced by cross 1, or with wild G♀s, the offspring were all G in the male sex, all L in the female sex.

Cross 1 establishes beyond question the recessive nature of the color character L. Cross 4 shows that the G♀, whether cross-bred or wild in origin, is heterozygous in color-character, bearing L as a recessive character. No homozygous G♀s have been found. Crosses 1 and 3 show that the male may be, as regards character G, either homozygous, GG, or heterozygous, GL, and cross 3 shows that it may also be homozygous in L, that is, LL. In other words, there is no correlation between the male sex-character and either color-character. There does, however, clearly exist repulsion between the female sex-character and the color-character G, so that, whenever an alternative is offered, femaleness and L go into one gamete, maleness and G into another. But such alternatives manifestly occur only in oogenesis, not in spermatogenesis. In no other way can we account satisfactorily for either the difference in result between the reciprocal crosses, 1 and 4, or the failure of cross 2 to produce the group L♂.

Bateson completes the explanation by offering the further suggestion that there is no disjunction of the sex-characters in spermatogenesis because the male does not carry the female sex-determiner at all, but is homozygous, ♂♂. Consequently, when the L character once gets into a male individual, as by cross 1, where heterozygous GL♂s are produced, then in the spermatogenesis of such an individual gametes are sure to be formed in which the male character is associated indifferently either with G or with L. This, however, permits of the production of (homozygous) L♂s only in cases where the egg bears the ♂ character associated with L, a condition realized in cross 3, but not in cross 2 or cross 4. Doncaster summarizes the case in a table, which is here reproduced as Table I.

TABLE I

Abraxas crosses, Doncaster's interpretation

	Parents	Constitution	Gametes	Offspring
Cross 1	*Lact.* female *Gross.* male	LL ♀ ♂ GG ♂ ♂	L ♀, L ♂ G ♂, G ♂	GL ♀ ♂ = *gross.* female GL ♂ ♂ = *gross.* male
Cross 2	Heterozygous female Heterozygous male	GL ♀ ♂ GL ♂ ♂	L ♀, G ♂ G ♂, L ♂	GL ♀ ♂ = *gross.* female LL ♀ ♂ = *lact.* female GL ♂ ♂ = *gross.* male GG ♂ ♂ = *gross.* male
Cross 3	*Lact.* female Heterozygous male	LL ♀ ♂ GL ♂ ♂	L ♀, L ♂ G ♂, L ♂	GL ♀ ♂ = *gross.* female LL ♀ ♂ = *lact.* female GL ♂ ♂ = *gross.* male LL ♂ ♂ = *lact.* male
Cross 4	Heterozygous female *Lact.* male	GL ♀ ♂ LL ♂ ♂	L ♀, G ♂ L ♂, L ♂	LL ♀ ♂ = *lact.* female GL ♂ ♂ = *gross.* male

If, in Table I, we substitute X for the symbol ♀, discarding the symbol ♂ altogether, and consider all individuals bearing X to be

[8] Vol. 27, p. 785, May 15, 1908.

females, we get no change in the character of the results shown in the column headed "offspring." See Table II. That is, the facts

TABLE II

Abraxas crosses, an alternative interpretation

	Parents	Constitution	Gametes	Offspring
Cross 1	*Lact.* female *Gross.* male	LLX GG	LX, L G, G	GLX=*gross.* female GL=*gross.* male
Cross 2	Heterozygous female Heterozygous male	GLX GL	LX, G G, L	GLX=*gross.* female LLX=*lact.* female GL=*gross.* male GG=*gross.* male
Cross 3	*Lact.* female Heterozygous male	LLX GL	LX, L G, L	GLX=*gross.* female LLX=*lact.* female GL=*gross.* male LL=*lact.* male
Cross 4	Heterozygous female *Lact.* male	GLX LL	LX, G L, L	LLX=*lact.* female GL=*gross.* male

agree with the hypothesis, X = ♀, no-X = ♂, quite as well as with the Bateson-Doncaster hypothesis. But if we apply Wilson's XX = ♀, X = ♂, hypothesis to the case, the expectations for crosses 3 and 4 will be exactly interchanged; cross 3 should produce only L♀s and G♂s, whereas cross 4 should produce all four possible combinations. This fact is decisive against the Wilson hypothesis and for that of Doncaster, or for such a modification of it as I have attempted to present.

We may, it seems to me, summarize our present knowledge of sex-inheritance under one consistent scheme, somewhat as follows:

1. Sex is not directly controlled by the environment, but is determined by internal (gametic) factors.

2. The determination of sex depends upon the presence in the zygote of a factor or factors which are inherited in accordance with Mendel's law.

3. Femaleness, that is, the capacity to produce macrogametes (eggs) depends upon the presence of some factor wanting in the male.

4. The presence of this factor is in heredity dominant over its absence.

5. As regards the transmission of this factor we can recognize two distinct categories of cases:

A. Femaleness is attained only when the differential factor is doubly represented in the individual. In such cases the female is a homozygote (XX), and the egg invariably transmits the differential factor. Sex determination then rests with the male parent, for half the spermatozoa possess the differential factor and half lack it. The female is a homozygous dominant, not, as Correns supposed, recessive; whereas the male is a heterozygous dominant, pure recessives being unknown.

B. Femaleness is attained whenever the differential factor is present in one only of the conjugating gametes which produce the individual. The gamete which transmits the differential factor is of course the macrogamete (egg), since this factor is not possessed by the male parent. The female is a heterozygous dominant, the male a pure recessive; homozygous dominants are unknown.

The experimental proof for the existence of these two categories of cases has been produced for class A by Correns, and for class B by Doncaster and others. Cytological evidence which strongly supports the interpretation given to class A has been produced by McClung, Stevens, Morgan and especially by Wilson. This evidence is fully corroborated by the work of many others. Direct cytological evidence for the existence of class B is not known at present, but may confidently be looked for.

6. The hypothesis which I advanced in 1903, that both sexes are in the same species sex-heterozygotes, is not supported by the considerable body of evidence since accumulated.

If, as seems probable, the differential sex-character has its cytological basis in the "X-element," as Wilson designates it, it becomes an interesting question, what is the cytological basis of those numerous morphological characters possessed by the male, but wanting in the female. For it is a well-known fact that such secondary sexual characters are in general both more numerous and more striking in the male than in the female. For this reason the male has been called the "progressive" sex, which takes on new or striking characters, that may or may not later be

shared with the female. Can we reconcile these facts with the idea that the female is a male plus something else? I think so, but we must concede also the possibility that the male may possess certain qualities not merely not manifested by the female, but even not possessed by it. I would offer the suggestion that we have a mechanism suitable for the transmission of characters exclusively male in the Y-element described by Wilson, the "synaptic mate" of the X-element, which takes the place in the gamete of a lacking X-element, and which would not be borne by a gamete possessing that element. If the primary difference between male and female is a defect in the male, the lack of something present in the female, that very defect would constitute a likely place in the germ-cell for new structures to find lodgement, which, behaving as the "synaptic mate," the material counterpart of the X-element would pass only into gametes lacking X, and so would produce structures peculiar to the male, and unrepresented in the female.

If this idea should prove to be correct, then we should have to revise the generalization to which Wilson gives expression "that so far as the eggs are concerned (and also those spermatozoa that contain the X-element) . . . every gamete contains factors capable of producing both the male and female characters, and that this is also true of all the zygotes." If the Y-element should prove to be the basis of characters purely male, then such characters would not be represented at all in gametes containing X, and cases like that described by Darwin, in which the hen-pheasant transmits to its hybrid male offspring in crosses characters of the male of its own species, could have but one interpretation, viz., that the hen-pheasant produces gametes lacking the X-element, as well as those which possess it. In other words, the hen-pheasant would seem to be a sex-heterozygote and so to fall in the same category of cases as the moth, *Abraxas grossulariata*, category B already mentioned. If so, the male pheasant should be incapable of transmitting in crosses characters peculiar to the female pheasant, if such exist.

This line of thought emphasizes the importance of reciprocal crosses in unraveling the mysteries of sex-inheritance and of the inheritance of secondary sexual characters. If the two categories of cases A and B really exist, there should be this difference between them. In A the male may transmit recessive characters peculiar to the female, but the reverse relation does not hold. In B, the female may transmit recessive characters peculiar to the male, but the reverse relation does not hold.

Further, there should be a difference in the two categories of cases in the Mendelian nature of fixed sexually dimorphic conditions. In category A, male secondary characters must be dominant in order to be fixable, *i. e.*, they must be represented in the Y-element by something not found in the X-element, but which will manifest itself even in the presence of the X-element. In category B, male secondary characters must be recessive in order to be fixable, *i. e.*, they must have their basis in the absence from Y of some element present in X, which absence will not be manifested if even a single X-element is present. For example, in *Abraxas* the pale *lugens* character is manifestly a defect character, due to lack of something found in *grossulariata* individuals, L being recessive to G. The gametic coupling of the female character with the *lugens* character, whenever a doubly differential cell division occurs, is doubtless due to the fact that the *grossulariata* character acts as the "synaptic mate" to the X-element, leaving absence of G (*i. e.*, L) associated with X. If in this cell-division G were associated with X, instead of with Y, then it would be possible to produce a stable sexually dimorphic race, with L♂s and G♀s, but the relation being what it is, no stable race can be formed in which the two sexes are G and L, respectively, but only races purely G or purely L in both sexes.

On the hypothesis suggested in this paper, accordingly, we can account for the fact that secondary sexual characters are more common in the male, if not its exclusive possession, even though the male is, as compared with the female, a defect race, or regressive variation. Transference to the female of characters originally possessed by the male alone could be accounted for by the duplication of the Y-element

in a heterozygous (XY) germ cell. In this case Y would become the "synaptic mate" of Y, and X would be left once more (as originally) without synaptic mate, fit instrument for the origin of new progressive variations, the characters determined by Y now being the common property of both sexes.

A clue to phylogenetic histories would thus be afforded us, giving point to such variations as the *lugens* variety of *Abraxas*. Thus it is possible (though nothing but pure speculation in the light of our present knowledge) that *lugens* may be the phylogenetically older form, characteristic originally of both sexes, and that the *grossulariata* character may have had its beginning in gametes lacking the X-element, *i. e.*, in a Y-element formed as the "synaptic mate" of X. Thus would arise *grossulariata* males, but the new character being dominant over its antecedent (*lugens*) would quickly be transferred to the females, since these contain a no-X (*i. e.*, a Y) element, in common with the males. But the X-element, as shown by Doncaster's experiments, is still unassociated in a gamete with the new *grossulariata* character, and so the fixing of that character upon the species is not yet complete.

How now may the occasional reappearance of *lugens* females be accounted for? Simply by reduction divisions, in spermatogenesis, in which the two Y-elements fail to segregate as normally, forming in consequence a sperm-cell which lacks Y (the *grossulariata* character). If such a sperm-cell fertilizes an egg of the constitution LX, a *lugens* female is certain to result.

If, as has been suggested, the presence in one gamete and absence from another produced by the same cell-division, of an "odd chromosome" (or other X-element, whether chromosome or something else) is itself a circumstance which favors the origin of new characters in the defective (male-forming) gamete, then we shall perhaps come to attach less importance than has sometimes been done to the supposed influence of sexual selection in evolution. For sexual selection, as has often been pointed out, can in no case account for the origin of new characters, and it is extremely doubtful whether it plays any part even in their preservation.

Striking new characters produced by internal causes doubtless persist unless suppressed by external causes, *i. e.*, unless they disqualify their possessor for competition in the struggle for existence. There is no more reason for supposing that males gain their gay colors and markings from choice on the part of the females, than that females owe their modest colors to choice on the part of the males. But if, as suggested, the very mechanism of gametogenesis is adapted for the production of new characters in the male, then we are afforded a basis for their explanation, without invoking external causes. Recent investigations tend strongly to show that variations of evolutionary significance are primarily internal. This is unmistakably so in the matter of sex. Even in cases where sex is subject to control by environmental factors, as in aphids and daphnids, the environment acts indirectly apparently through the control of the same internal factors which govern sex in other animals. If the mechanism which I have suggested is not their true source, then we may well look for other possible internal mechanisms.

Orthogenesis also, the persistent tendency of an organism to vary in a particular direction, irrespective of the action of natural selection (if indeed orthogenesis be a reality, which, however, I do not assert), orthogenesis then would find an explanation along similar lines to those which I have suggested. For if a Y-element arose because of the very lack of X, then it would be natural for it to continue to grow until it became the full complement of X.

I make no apology for offering the hypothesis, or hypotheses, contained in this paper. I would have every reader recognize as fully as I do that they are hypotheses, and I shall be quite content if they suggest lines of investigation which will further elucidate the nature of sex and the manner of its inheritance.

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Zoological Laboratory,
Harvard University,
February 10, 1909

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 12, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE AMERICAN COLLEGE AND LIFE[1]

IT is in no wise due to my own choice and moving that I am called upon to take part in this discussion. Just because philosophy calls for so much reflection, I consider it a proper part of a philosophical student's business to keep himself relatively naïve, unreflective and directly practical regarding at least some important portion of his own life's business. Upon certain problems it is my duty to reflect, in as critical a fashion as I may. I do reflect about those problems with a good deal of persistence, and I discourse upon those topics at wearisome length. They are topics of logic, of metaphysics and of general ethical doctrine. In the rest of my life I try to stick to business without much reflection. Such naïveté need not mean, I hope, either carelessness or unfaithfulness. It may mean, and in my case I hope that it does mean, so far as that part of my vocation is concerned, practical absorption in tasks. Now part of my vocation is that of a teacher. And while, as I said, I reflect a great deal upon the metaphysical and other topics concerning which I have to teach, I have never been disposed to reflect much about the practical business of teaching itself. I teach as I can. When I observe that I teach ill, I try to mend my ways. I can not tell much about how I try to mend them. I can not formulate a theory of teaching. When I observe that a student

[1] An address given before the Section of Education at the Baltimore meeting of the American Association for the Advancement of Science.

is inattentive, I try to interest him. When he is wilful, I try to get past his wilfulness as I can. I do not know what, as a teacher, I accomplish. I simply try my best. And I suppose that, for me, with my limitations, such relatively unreflective efforts to do my best are most useful to me as a teacher. And similarly, as to the general conduct of a college, I avoid theories. I attend various faculty meetings, and have a natural and somewhat uncritical fondness for the wisdom of my administrative leaders and colleagues. But I do not understand college administration, especially under modern conditions. I have listened pretty patiently to some long and learned faculty debates upon the problem of college entrance examinations. I have never been able to comprehend the subject. I prefer to reflect upon such straightforward and solid problems as that of the absolute. I leave such airy topics as the reform of the secondary schools to those who know about them. There seem to be many such knowing persons. I hope that together they have wisdom enough to meet the issues of their time. But never, by my own choice, would I venture to take part in the counsels of the wise regarding the theory and the general conduct of what is called the American college. For I know that I am merely a servant of the college, who can do best by holding fast to my own work. Since, however, men much wiser upon this topic than I am have insisted upon my taking part in this debate, I offer my views simply as the personal impressions of a college teacher, who has tried for years to be faithful to his calling, but who has no general theories as to the college. I come here simply as *ein Thor*, who, if I have any sort of insight into my practical tasks as a teacher, or into the value of the American college for life, possess this insight merely as one who am perhaps a very little *durch Liebe erleuchtet*. I am told that testimony is desired here, as well as comprehension. Upon these topics my comprehension is of the slightest. Let me merely offer my testimony.

I may begin the summary of my impressions by relieving you of the notion that I have any right to speak as a representative of a distinctively Harvard point of view. I have tried to serve Harvard as I could for more than a quarter of a century. And my personal love for Harvard and for my work there is indeed at the heart of whatever I can say. But I am a graduate of the University of California. My educational prejudices were first formed under the conditions of far western state university life, and were later modified by study at the Johns Hopkins University. I keep many of my early prejudices still. And they result in this impression, viz., that some of the most important problems of what your title calls the American college will have to be worked out under the conditions of the great state universities. The center of gravity of our future American academic life can not always, can not, I think, very long remain east of the Alleghenies. Through a perfectly natural and inevitable evolution, the state universities of the middle west and of the far west, supported as they are, and will be, by the vast resources of their own communities, and guided by constantly improving educational ideals, will within a generation or two occupy a very nearly central place in the academic life of our country. I do not imagine that the older eastern institutions will fail also to advance rapidly and effectively. But they will in many ways need to undertake functions more closely analogous than their present functions are to those of the state universities. That is, as institutions whose influence

will more and more be felt in the organization of the whole system of public education in their respective provinces, as trainers of our new coming foreign population to the duties of citizenship, as servants of the state, as centers of guidance, both for technical education and for research, the older eastern universities will, like the western state universities, undertake a variety of tasks which they now very unequally recognize and pursue. Hence, as I believe, when we think of the future of the "American college," we should remember that this future is bound up, inseparably, with the future of the American state universities, and with the future of institutions whose functions will be in more and more ways analogous to that of the state universities. It is, therefore, simply useless to try to think of something called "the college" as if its function could be sharply separated from that of very various grades and types, both of technical and of professional schools. I think that the usual disposition of many educational theorists to insist that, for the sake of a dictionary definition of the term college, and for the sake of some historical tradition, such a sharp separation of the functions of "the college" from the technical school on the one hand, and from those of the graduate professional school on the other hand, should be made where it does not at present maintain itself —I think, I say, that this usual disposition is misleading. Look at the state universities and see what the work of "the college" with them always has been. It is a work that in various parts of the same institution may involve training in agriculture, in mining, in classics, in political science, in philosophy, in music and in civil engineering. One may protest as one will that one misuses the term college when one talks of a college of agriculture, and that one ought instead to speak of a technical school of training in agriculture. One may raise as much as one pleases the question whether a liberal education, devised by some one who does not love agriculture, should first be required of students of agriculture, who should then only be allowed, as graduates, to undertake their more technical studies. One may insist as one chooses that agricultural schools, if they are to exist at all, should be separated from the institutions that undertake to educate their pupils in the sense of a higher cultivation. But whatever one thus does by way of formulation, of definition, and of criticism, the state universities will continue to show that the best thing you can do for an agricultural school is to make it an integral part of an academic institution wherein Greek and metaphysics and history and the science of government are also taught; while one of the best things that you can do for the young men who are to be trained in the humanities is to keep both them and their teachers in pretty close contact with the pupils and teachers who are engaged in technical studies. The history of more than one western state university has been the history of the gradual humanizing of a little group of technical schools. A college of agriculture, as it grows, adds to its resources, perhaps, a department of music, a "classical college" is joined to schools of engineering which have already been formed, and thus something is developed which is indeed a highly composite institution. Its functions include those of graduate and undergraduate, technical and professional schools, and also the functions of which we are talking when we speak of the American college. The interesting feature of such institutions is that our lines of division become more and more obviously artificial when applied to them. The function of "the college" in their case becomes intertwined with other func-

tions, technical, professional and scientific! Is such intertwining, is such overlapping and interlacing of functions unwholesome? I think not. I myself welcome the union of technical studies with those which involve a more general cultivation. Men grow so differently, mature at such unequal rates, are cultivated by such different sorts of work, and can use their general cultivation, if they have any, for such various technical purposes, that, for my part I suppose one of the notable functions of an academic institution to be the uniting rather than the further sundering of the various more or less learned activities of modern life, the humanizing of engineers, and the preparation of the young followers of the humanities for some practical service of mankind.

Whatever the functions of "the college" then, it is impossible to treat these functions so as sharply to sunder them from the functions of technical schools. We ought not to say to any one separate class of young men: You want cultivation. That is good. We will therefore give you four years of pure cultivation. Thereafter you shall be ready to undertake something else, which is not cultivation but is your life-work. There are indeed some men who are best trained in just this way. But there are also very various sorts of men in whose cases the most different kinds and degrees of union of technical with non-technical types of training form the best means of education. Our undergraduate instruction must reckon with these various sorts of men. We must offer to them various intermediate kinds of education. And we need to have these various sorts of men kept in social relation with one another as they mature. The fortunes of "the college" must not be sundered from those of the technical schools. And this is what the state universities have taught us.

Equally impossible it is to keep asunder, as some theorists wish to do, collegiate instruction and what is called graduate professional instruction. I have for years heard colleagues of mine protest against permitting instruction which they regarded as professional in its nature to count towards a college degree. I have never been able to get from these colleagues any general definition of what, in the modern world, constitutes the distinguishing mark of a professional study. Of course there are professions, notably law and medicine, which can draw their own sharp lines between their particular professional studies and all non-professional studies. These professions wisely begin their training at a definite point, preferably no doubt with college graduates. But then these particular professions are concerned with topics, and with a sort of technique, which can be begun only when the student has a fairly definable degree of maturity. You can not make a young boy a nurse, and you can not wisely begin to give him early clinical instruction. Fragments of legal lore, introduced into undergraduate instruction, tend, we are told, rather to hinder than to help the later work of the law school. So here sharp lines can be authoritatively drawn. But in modern life there are many professions, and, in case of some of these, the boy can already do what it will be almost necessary for the future professional man to have done as early as possible. I was once told by an old sea-captain that an essential part of his life's training was learned in his sailboat, in the harbor at home, when he was a boy, and that he therefore wholly doubted the power of even the best modern naval training school to make a trustworthy ship's officer out of anybody who had not begun to learn the sailor's trade in early boyhood. I need not say that my captain was not alone in this con-

viction, which is that of the old fashioned mariners generally. But what is true of sailors is in various degrees true of other callings. Good engineers can well be made by a training that begins in boyhood, and that certainly ought to include undergraduate training as well as graduate training. And yet I am sure that an engineer ought, amongst other things, to be as cultivated a man as he can be made, and so I am sure that, in his undergraduate days he ought to have an opportunity for various sorts of cultivation that you and I would agree in calling collegiate. Future teachers, future social workers and clergymen, coming civil servants or colonial officials, embryo scientific investigators of all sorts —all these need, during their undergraduate years, training such that nobody can rationally distinguish between that portion of this training which is professional in nature and that portion of it which is apt to add to their general cultivation. Is training in the use of good English a professional study? I know many workers in various professions—contributors, let us say to scientific journals—who would be much better men in their own profession, because decidedly clearer in their wits, in case they had been better trained as school boys and as undergraduates in the accurate use of plain English. Yet what study could be mentioned that is a more typical instance of a so-called culture-study?

I insist then that one can not in any general way distinguish between the educational offices of technical and professional studies on the one hand, and the studies productive of cultivation upon the other. I myself, for instance, ought to teach logic so as to make it professionally useful to future engineers and to future clergymen alike, and to any cultivated man as well, in case he can be induced to be for a while reflective. If I can not do so, that is my defect as a teacher of logic. It is useless to condemn me to the vague task of simply so teaching logic as to exert a cultivating influence over people who have no trade and who have not yet chosen a profession. As a teacher of logic I ought to be required to appeal to anybody who chooses to try the value of my personal appeal to him, whether he is a professional student or a technician, a graduate or an undergraduate.

In a college then, we ought to offer the youth such learning and such training as may prove to be useful in fitting men of their age for the life that they are going to lead, in so far as that is indeed a life which involves intellectual training at all, and in so far as they are youth who are mentally and morally fit to be taught during those years of their life. The unfit, the stubbornly unwilling, the unworthy, we must reject or dismiss. But whosoever will may come, if only the secondary schools have made him fit for a grade of training which experience shows to be in general adapted to reasonably normal folk at his age. And when we get him we ought to make him work as hard as is good for him, and not a whit harder than is good for him, at whatever study will best fit him for his life, whether that proves to be a technical or a so-called professional study or not. Of course we must try to add to his technique general cultivation, of the richest sort that we can get him to assimilate. We can best succeed in that if we teachers keep together ourselves, and unite in one institution the work of very various sorts of scientific and of learned men. Hence, while we shall indeed differentiate more and more our professional and technical schools and modes of training, we college teachers do ill if we unnecessarily separate ourselves and our work from close touch with those of our colleagues whose tasks are more technical and professional than are our own. Only

by union with such teachers can we keep the college near to life.

As to our present condition, in the American college of to-day, I agree with our critics that many college boys do not now work hard enough. The remedy lies, of course, in giving such boys more good work to do, and in employing more instructors whose duty it should be to follow them up personally in their work. The remedy also lies in increasing the effectiveness of our systems of individual advice—in brief in individualizing our methods of dealing with the individual. The remedy does not lie in banishing the work of the investigators to separate institutions, nor in differentiating a colony of pedagogical neuters, who can not generate ideas, nor add to knowledge, but who, as one imagines, can therefore the better teach. We have enough of the barren and unproductive minds at present amongst our college teachers. We want more living and growing investigators than we have. And we want our productive investigators to do more undergraduate teaching than they do. There is a place in the college, of course, for the great teacher who can impart knowledge, but who can not add to it, if indeed his is not really an unproductive mind, but a mind that, like that of Socrates, the prince of teachers, produces indirectly, by acting as the midwife, and by delivering others of the ideas with which their own minds are pregnant. But every effort to separate even this singularly valuable class of teachers from their investigating and originating colleagues, or to keep the investigators as a class by themselves, in institutions to be called universities, and to be sundered from our present colleges—every such effort, I say, seems to me to be in the direction of regression, of pedantry, and if I may speak frankly, of obscurantism. We want teaching and investigation to become more and more what they ought to be—one and inseparable Some investigators indeed can wisely teach only advanced pupils. Let them confine themselves to such work. Some good college teachers add nothing notable to knowledge. We welcome them whenever they do sufficiently good work of their own kind to make them valuable for the college. Some professional training, by reason of its topic or of its grade, must keep itself well apart from more elementary instruction; let it then do so. But let us not be so terrified by mere names and definitions that we shall set off by itself, in unprofitable isolation from the college, that sort and grade of professional instruction which can also help to awaken and to discipline youth at the collegiate age. And above all let us not be so much the slaves of the mere name *college* as to undertake to draw a sharp line which, in modern life, has no longer a place—a sharp line between all sorts of undergraduate and all sorts of graduate instruction. Many of our graduates need cultivation, badly enough, as all of us know. Many of our undergraduates need pretty advanced studies to wake them up. Let such have them.

As for the unquestionable present evils of too little hard work and too much sport on the part of the college undergraduates of to-day, let us meet these evils in two ways:

1. In general, let us seek to assimilate college work more rather than less to that sort and grade of professional work which calls out a young man's energies just because he feels that in such work something is at stake that is, for him, personally momentous.

2. In detail, let us make the college boy work harder by giving him more work to do, by following him up more closely and individually, and to that end, let us employ more teachers whose work of instruc-

tion shall be individual and personal. Let us abate the evils of sport by fearlessly excluding the mob from our intercollegiate contests, and by rigidly limiting the number of those contests.

In any case, however, let us beware of those theorists who, in the name of what they call the American college, want to sunder afresh what the whole course of our modern American development has wisely tended to join, namely, teaching and investigation, the more technical training and the more general cultivation of our youth, as well as the graduate and the undergraduate types of study. I should abhor the name college if this mere name ever led us into such a backward course as some are now advocating.

Let me say, in conclusion, that, in agreement with Mr. Flexner, I myself believe that a large reform of our relations to the secondary schools, and especially an essential change in our method of college entrance requirements and examinations is called for by the present conditions. But over that whole topic, for my poor wits, the clouds of mystery still hang thick. I leave the matter, and all these now uttered prejudices of mine to the judgment of those who appear to think that they know.

JOSIAH ROYCE

AMERICAN COLLEGE EDUCATION AND LIFE[1]

THERE is evidently a feeling in the minds of the public that there is something the matter with our colleges. The more sensitive and alert educational authorities are likewise aware of certain defects, although they may not agree upon the causes. The more or less definite feeling is that college work on the one hand lacks intellectual seriousness, and on the other fails, somehow, to connect vitally with the present needs of society. Questions as to the length of the course, or the threatened partition of the college between secondary school on the one hand, and the professional schools, including the graduate school, on the other, are really subordinate to this broader question of seriousness and connection. If the college is really worth while we shall doubtless manage the external organization of our system so as to secure its continuance. If the conviction becomes general that it is a survival from the past rather than a useful institution for the present, the really vigorous and ambitious young men will pass it by, and the public will not care to maintain it for the benefit of those who wish merely to spend four pleasant years.

The two chief questions, I conceive, are the value of its intellectual ideals and methods, and the value of its corporate or social life at a certain period in the development of young men and women. I shall confine myself chiefly to the former, in the belief that the intellectual problem needs to be attacked first. The present paper aims to show (1) that the work of the colleges up to about twenty-five or thirty years ago fitted the social situation in both ideal and method; (2) that in the past three decades there has come to be a gap between theory and practise to which the colleges are only in part adjusted; and (3) that the solution is likely to lie through a reconstruction of the college ideal of liberal education under the influence of new vocational methods and ideals. In return we may hope for a gradual permeation of vocations and social institutions by the new spirit and method, which will complete the readjustment between college and life.

I. THE FORMER IDEAL AND METHOD OF COLLEGE AND OF LIFE

The intellectual ideal of the college has

[1] An address given before the Section of Education at the Baltimore meeting of the American Association for the Advancement of Science.

been that of a "liberal culture." This formerly meant three things: As contrasted with studies pursued for utilitarian ends solely or chiefly, it meant genuine intellectual interest. As contrasted with studies determined by the external requirements of future vocation, it meant study directed by the inner, personal valuations, aptitudes, or desires of the scholar himself. In both these respects it meant "liberation," and freedom—freedom for the life of the spirit as over against external necessities or constraints. And in the third place, as predominantly classical, it gave a glimpse of another and different civilization. To the boy or girl brought up in the meager and isolated environment of New England hills or pioneer farm it opened a vista. It gave the æsthetic value of detachment. Some of finer temper caught the full inspiration of converse and companionship with the great minds they came to know. In this sense it was really humanizing. And for ordering one's life and measuring life's values, how could one better gain a point of view from which to see life steadily and whole than in the perspective of the best that had been thought and said?

Now this general scheme of freedom and individualistic literary culture fitted admirably the religious, political and social ideals. For protestantism was religious individualism. Governments were supposed to exist to protect individuals in their natural rights. With practical economic equality, and in a rural, independent mode of life, freedom from external constraint seemed to be the chief social good. And as regards utilitarian demands, in spite of the hard conditions under which life was often led, it was a tradition from early colonial days which had not failed of reenforcement that man's life did not consist in his possessions.

The prevailing *method* of classical study, and of the mathematics and philosophy that went along with it, was also strikingly adapted to the professional training and general social order of the period. For the three professions for which the college prepared were occupied chiefly in deducing the consequences from fixed first principles. Systematic theology or grammatical exegesis was the minister's task in the seminary. The statutes, on the one hand, and past decisions on the other, with some fundamental conceptions of natural rights, were the fixed datum of the lawyer. The physician might be less certain of his ultimate principles, but whether "regular" or "homeopathic," his method was about as dogmatic; and as for society, its social, political and moral standards and categories were all supposed to be established. Even the movement for the abolition of slavery needed only the familiar conceptions of rights and freedom. The moral standards could still be regarded as unchanged. The scriptures and the Declaration of Independence could be appealed to, and although some went so far as to denounce the Constitution, American society as a whole strove rather to make its attitude seem to accord with the Constitution than to admit frankly that social needs had outgrown the Constitution. "Legal fiction," through which the courts like to preserve the semblance of fixed principles, could probably never have been taken so seriously, even by the law itself, if it had not suited on the whole the conservative temper of American society. On the one hand, therefore, the learned professions, on the other, society as a whole, had a relatively fixed system.

How admirably the classical and mathematical method of the time prepared the student for such a scheme of fixed conceptions! Syntax and prosody presented a perfect system, a logical whole, which

needed not to be investigated, but to be learned and applied. The future theologian learned respect for authority as he searched the scriptures of Hadley and Goodwin, or Liddell and Scott. In the statutes and decisions of Harkness the future disciple of Blackstone gained practise in tracing subjunctive or dative back to its constitutional rights and limitations. To watch for agreement in gender, number and case, remains, I am told by legal educators, an unmatched training for legal procedure. Finally, Euclid's axioms were the favorite symbol for the supposedly fixed rules of eternal right which every good citizen should learn to respect and obey. If there was any doubt as to this fixity the course in philosophy was calculated to remove it.

This exact adaptation of the method of college to the methods of the professions seems to account, in part at least, for the results achieved in the way of efficient training. It was maintained and the claim need not here be challenged, that the old college training gave power and effectiveness. Modern experimentation has tended to discredit the abstract conception of "power," gained once for all by some hard study, and then applied to any task that presents itself. But the old training was not isolated or in a vacuum. It was about as near the whole habit of mind and technique of method which later life would employ as anything that could be devised. It was thus essentially, although unconsciously, vocational in method, while "liberal" in ideal.

Both in its intellectual ideal of liberal or free culture, and in its method of instruction the college was therefore well fitted for its former place in American society. No wonder that the educational creator pronounced it all very good. And so long as the Sabbath Day lasted the system was beyond criticism.

II. THE PRESENT SITUATION

The variety of subjects now offered, and the elective system as the method of determining the student's course, are in part due to the activity of science in organizing new materials. With the wealth of resources offered by the natural and social sciences and by modern literatures it seemed impossible to restrict access to the city of the elect to the single straight and narrow path formerly followed. There must be gates on four sides instead of on one. But there has also been a social factor in the change, even if it has not always been consciously recognized.

Economic and social expansion has increased greatly the number of occupations for which trained intelligence is needed. Technical schools have arisen in partial answer to this demand, but the college has made its responses also through its variety of subjects with its freedom of individual selection. The progress of science, as represented especially in the graduate school, has no doubt in many cases given to subjects a specialized mode of treatment which is as technical in its way as the method which any professional school pursues. This apparently suits well the needs of one of the new vocations for which the college has come to be a preparation—that of the teacher. The young women who have come to form so large a part of our college constituency, and who for the most part have been looking forward to teaching, have found their needs well met. But for other occupations, especially for non-professional life, no such vocational connection has been worked out. Studies have become individualistic and detached in a far greater degree than was true of the old curriculum, which was really, though unconsciously, vocational.

But economic and social expansion has had another consequence for the college. It has increased greatly the number of

persons financially able to enjoy the best opportunities available. And whatever the attraction which literature or science may have for some of these intrinsically, or whatever the value a college degree may assume as a mark of social distinction, the real standard of value generated by this whole process, as Professor Sumner has pointed out, is that of "success." The studies of the college course seem to bear little relation to this ideal.

And this leads us to a broader statement. The fixed ideals and standards of the older society, which kept men in their place and held them to their work, have broken down. The churches are feeling the same difficulty. Men are largely absent from the pews. They, or at least many of them, are not taking the churches seriously. Many in former days were kept in the church by the general ideals of the community, and so in college many who had no absorbing interest in the work for its own sake nevertheless yielded to the spirit of college and society, and worked under the general idea that the discipline of the college course was validated in a superior law. Such students no longer feel any external pressure. Serious-minded men are groping for new conceptions in religion, economics, politics and law. But these have not been thoroughly enough worked out as yet to replace the old fixed control. Not only the flippant, but the earnest are more or less at sea as to standards and values. As Mr. Crothers puts it, even "the way of the benefactor is hard."

Some, indeed, seem to feel fairly well satisfied with the situation. President Eliot in his recent work on University Administration has a good deal of faith in the present system if there is a proper intrinsic relation maintained between courses, supplemented by a judicious arrangement of the time schedule. Some colleges have changed their schedules so as to require residence at the week end from those students who had fallen into the habit of spending their leisure half week in neighboring cities. But such considerations, as well as reports like that of the Harvard Committee, and the frank statements of students themselves, point to a real defect. Some would attribute the difficulty entirely to the presence of a frivolous class. But this is evasive. Many, if not most, even of this class, settle down to hard work the moment they enter business or a professional school. And even those who are not on principle averse to anything like strenuous effort feel a certain unreality in the whole situation. There seems to be not only the attitude of "detachment" belonging to the older conception of "liberal" education, but also an attitude which the æstheticians call "make-believe." Now detachment, or even make-believe, may be valuable as a factor in developing a broader, deeper interest, and a more significant, richer purpose. But four years of make-believe seems to be overworking this factor. The young men themselves are coming to think so, and the public at large, while taught to respect the wisdom of its educational experts, is beginning to ask questions.

III. SUGGESTIONS TOWARD READJUSTMENT

The general line along which remedy is to be sought for the present lack of seriousness and lack of connection seems to be *a reconstruction of the college ideal of liberal culture.* This promises to be brought about by a greater introduction of the vocational element and spirit into college work. And this introduction of the vocational into the liberal is being made possible and desirable because *the vocational is being itself permeated and transformed by the liberal.*

The reason for the old-time sharp oppo-

sition of the liberal to the utilitarian and professional was, as we have noted, to protect the intellectual interest and keep the self free from alien constraint or narrow bounds prescribed by vocational conditions. But a new face has been put upon this situation by the development which is going on in the industries and occupations, and in some, at least, of the learned professions. For the various occupations are being organized more and more along scientific lines; they are becoming permeated with intellectual and æsthetic interest; they demand of themselves a wider reach and stimulate a broader survey. In so far as they do this they break down the distinction between the liberal and the vocational. Not the way in which knowledge is to be used—much less the fact that it is not used at all—but the method and spirit in which it is pursued on the one hand, and its breadth of human interest on the other, make it liberal. Any study is liberal, if pursued in a scientific manner and given significance for human life. Such studies call out a widening self. In such studies the mind comes to its own. In such it gains power. In such it is no longer determined by needs or conditions foreign to itself. Rather it is using these needs and conditions as the most effective instruments for asserting itself.

Medicine is perhaps the farthest advanced of the professions in this respect. And the college studies pursued by the future teacher, which are professional so far as their future use makes studies professional, show the absurdity of the old distinction on the basis of utility, or non-utility. For Latin or mathematics as pursued by the future teacher of these subjects is probably more liberalizing than when pursued by those who do not expect to make use of them.

Nor has the process of permeating vocations with scientific interest stopped with the so-called professions. Modern commerce and industry involve the use of intelligence in ways that are properly scientific. And there is no reason why, if studied in their historic development and in their bearing on human welfare, they may not call out as broad and as human an interest as any other field of human activity.

This mutual permeation of the vocations by the scientific and of the liberal by the practical looks, indeed, toward a more effective and positive type of "freedom" than the older conception of the more romantic and negative sort, which sharply opposed the interests of the self to the sphere of its action. The older freedom from constraint corresponded to the formal freedom which was so important an element in political and religious liberty, and which was so prominent an ideal in the last of the eighteenth and during most of the nineteenth centuries. The courts by their distinction between law and fact, which tends to prevent the contamination of legal doctrine by recognition of actual conditions, maintain this theoretical freedom as a basis in many of their decisions. But social and economic facts emphasize that it is positive resources which give the only freedom that amounts to anything. Psychological analysis shows that only as the mind has both ideas and positive control of its instruments is it free in any considerable degree. The student is then free of his world, is fitted to lead a free life, is having a liberal education, in proportion as he is getting such control of the instruments of knowledge and such efficiency in dealing with his fellow men as makes him master not merely of his ideas, his emotions and his purposes, but of his world. The old individualism in education, as in religion, was largely to lose or hold off from the world in order to save the soul by culture.

The new scientific and social situation demands, and in increasing degree will make it possible, that the educated man shall control his world. And in so doing he will save himself. When this conception is embodied in the college there will be no lack of seriousness.

When the colleges have made their work once more a genuine and serious preparation for the new social situation they will be able to give society in turn the aid it needs in changing from the old fixed conceptions, and finding a new type of social order—an order that shall make larger provision for progress. This help, I believe, is to come through the influence of the newer experimental method which largely under the influence of our graduate study is coming to leaven the best work in all subjects. It has its fitness for our new conditions as conspicuously as the older method fitted the conditions of a relatively fixed status.

The laboratory method of studying the sciences began to gain ground in the colleges at about the same time as the introduction of the elective system. It has been strongly reenforced by historical or genetic conceptions given prominence by the doctrine of evolution. Although still very imperfectly carried out, it is replacing more and more the scheme of fixed conceptions and deduction from established rules which constituted the older syntactical, mathematical and moral systems. If this can be carried over into professional conceptions and social organization there will be once more a close connection between the college and society. Medicine and philanthropy have already made notable progress. Theology and religion are feeling the need of reconstruction. The courts are perhaps necessarily the most conservative elements—unless possibly we except schools and colleges—but when legal education has felt fully the force of genetic study we may expect that both criminal and civil justice will consider in greater degree actual human and social conditions in controlling human relations.

And if the established professions need a new method to enable them to fulfill their vocation in the society that is to be, business and industry need the aid of scientific method and standards to make them professional in the true sense. Considering these occupations as non-professional, we have left them no test for the success that every normal man wishes to secure, but that of economic gain. And since economic gain may result either from service or from exploitation, our educational theory and training have lent no such powerful support to the conception of public service through one's vocation as the scientific standards of law, medicine and teaching afford members of those professions. As President Eliot has pointed out, this purely financial standard has not proved a conspicuous success even from the standpoint of efficient management of business enterprise. Is it not desirable that education should try to introduce other and more scientific standards? And is it too high-flying an optimism to hope that the time may come when it will be considered as unprofessional to manage a country's industries or transportation or banking with an eye principally to financial gain as it now is to practise medicine with such a standard of success? The scientific and the ethical here go hand in hand.

The professional schools themselves are not likely to embody this method in its full significance in their work. The function of the college intellectually is to make this the dominant temper of the student.

And the second intellectual function of the college is to give material for the future citizen. First of all, he must know

society. The social sciences ought to be strongly developed. But training for a democratic society is not limited to a peculiar subject. Nothing human is foreign to the purpose of the college. But it is a fair question whether literary study may not be for the college less an end in itself and more an avenue through which one comes to know and sympathize with all sorts and conditions of men. And even the natural sciences need not hesitate to let their bearing on human welfare appear.

An experimental method and a social standpoint are, I conceive, the two respects in which the college should perform its office of liberal training in a way suited to our new conditions.

In view of the fact that women now form so large an element in our colleges, it may be permitted to point out some special applications of these considerations to woman's education on the one hand, and to the determination of woman's place in the social order on the other.

College education for women has thus far followed essentially the lines laid down by the general system already in vogue. "Equal opportunity" was the watchword at first, and it is probable that any differentiation in kind might have been regarded as involving inferiority in standard or value. "Woman's work" is still, it must be confessed, often treated by the world in general as implying a depreciatory estimate. As already noticed, a large number of women, looking forward to the occupation of teaching, have found the existing courses largely vocational. For this, or other reasons, the lack of intellectual seriousness has thus far not been so much in evidence as with the men. But as an increasingly larger proportion of the women students will not become teachers, the question of connection between college work and after life is likely to become more acute. The need for introducing into college more material of a vocational sort, and conversely of permeating woman's vocational work of all kinds with a scientific method and a broadly human interest, is likely to become increasingly evident. The work of the woman in the home has lagged far behind the occupations of men in point of organization and of the use of scientific method. An educated woman is apt to feel, vaguely, that the whole household life—once the center of all the industries, and the place where discovery and invention had their chief seat—has now been left behind in the progress of civilization and is no longer a field for the exercise of intellectual powers of the highest order. This inevitably tends to depreciation of such occupation, and to strain in the family life.

Some would find the remedy by purely sentimental and emotional exaltation of home life. They would in effect continue the separation between the scientific spirit and the home. Is it not more promising to work, rather, along the lines suggested in the case of men's vocations, and try to liberalize women's vocations by scientific methods and a more broadly human standpoint? It is not yet sufficiently recognized, for example, that in modern city life the home is virtually coterminous with the city. The sanitation, the food supply, the health of the home are now dependent on municipal conditions; the education of the children, the influences that surround them, the ideals that influence them are reached chiefly by forces that are civic and philanthropic in a broad sense, rather than domestic in the narrow sense. And further, while the organization of production, the conduct of litigation, and various other traditional vocations are likely to remain predominantly in the hands of men, it is increasingly apparent that as wealth increases beyond provision for bare necessities woman becomes the more im-

portant factor in determining the course of consumption. Vocational training for woman will then be conceived broadly enough to enable her to plan not only economically, but with taste and refinement for those satisfactions that are permanent and genuine, and also with intelligent judgment for those that make for the larger social welfare.

And the final application of the experimental method in this connection lies just in the determination of what women's vocations are ultimately to be. The older society had no doubts. The religious, economic, political and social status of woman could all be deduced with perfect exactness. It was as easy as the agreement of a verb with its subject. The present equilibrium is unstable. Is it not a scientific method to work out the problem with careful reference to the new conditions as they emerge, rather than to decide by past history or fixed conceptions?

In conclusion I may barely hint at a question which no doubt arises as to the bearing of this whole discussion on the college as a distinct organization. If professional education is to become liberalized, what need of the college? And if the spirit of investigation is the main factor, why again the college? Why not the university joined directly to the secondary school? In the long run I think this is likely to depend on the need of a factor which has been barely referred to above. Effective education depends in part on a scientific factor, but there is also a personal factor. One must know his fellows and how to cooperate with them. This is increasingly important with the growing complexity of society. And this efficiency in dealing with others is not easily secured in professional or graduate school where the emphasis is on subject and method, and the life is individualistic. If the college can maintain a corporate life in which knowledge is vitalized, in which there is actual give and take, actual sympathy and friction, active interchange not only between mind and mind but between will and will, then it will find its own place, and live secure.

JAMES H. TUFTS
UNIVERSITY OF CHICAGO

THE PROPOSED HAWAIIAN MEETING IN 1910

THE action taken by the general committee of the American Association for the Advancement of Science at the Baltimore meeting in again unanimously re-affirming a resolution adopted at the Chicago meeting of a year ago to the effect that it was desirable to hold a meeting of the association in Honolulu during the summer of 1910, provided suitable arrangements can be made, is quite generally regarded as a flattering acceptance of Hawaii's cordial and urgent invitation.

All Hawaii is united in the desire that their invitation be extended to each of the individual members of the American Association for the Advancement of Science, and of the affiliated societies, and to their families and friends. Keen delight is expressed at the prospect of welcoming the scientific men of America to the "Land of the Heart's Desire," for such a meeting and outing. Hawaii is prepared and willing to do all in its power to make the meeting a large, notable and important gathering not only of the scientific men of America but of the other countries that border on or have possessions in the Pacific Ocean. To this end elaborate preparations are being made for the entertainment of all who may attend.

A strong local committee has already been formed. They have printed and ready for general distribution a number of pamphlets setting forth the things prospective visitors will want to know about Hawaii. The probable cost of the trip from the east will not necessarily exceed $300. An especial booklet emphasizing the desirability and advantages of Honolulu as a summer meeting place and the things of interest to be seen by the scien-

tific visitors in the island was especially prepared for distribution at the Baltimore meeting. Those who desire the literature or wish information about the trip or are in any way interested in the meeting are requested to address Mr. Albert F. Judd, Secretary Hawaii Committee, Judd Building, Honolulu, H. I.

It is desired that you state to the committee the particular subject that interests you most that detailed information may be sent you thereon. The farther advantages of having your name and address will be that it will enable the local committee to keep you informed of special rates and other matters of interest to those contemplating the journey. It is desirable at the present time to secure the assurance of your interest, the matter of coming can await further consideration.

WM. ALANSON BRYAN

SCIENTIFIC NOTES AND NEWS

THE meeting of the Chicago Academy of Sciences on February 23 was in honor of Charles Darwin. Professor C. O. Whitman, of the University of Chicago, gave an address on "Some of the Principles of Organic Evolution as revealed in the Pigeon World."

THE Rochester Academy of Science held on February 22 a meeting in commemoration of the Darwin centennial. Addresses were made by Professor C. W. Dodge, on the life and work of Darwin; by Professor H. L. Fairchild, on Darwin and geology; and by Professor W. D. Merrill, on Darwin and botany. An exhibition was made of material illustrating evolution.

WE learn from *Nature* that at the meeting of the Royal Society on February 18, telegrams of congratulation on the hundredth anniversary of the birth of Charles Darwin were read from the University of Christiania, the University, Kharkoff, the Naturalists Students Association, Kharkoff, the Society of Naturalists, Kharkoff, the council of lecturers, Moscow Women's University and the Swedish Academy of Sciences, Stockholm. The president reported that telegraphic acknowledgments and thanks had been transmitted to the senders on behalf of the Royal Society.

A MEETING of the Leeds Naturalists' Club was held on February 15 to celebrate the Darwin centenary, when Mr. Harold Wager, F.R.S., delivered an address on the life and work of Darwin.

M. H. POINCARÉ has been elected president of the French Bureau des Longitudes.

THE University of Liverpool will confer its doctorate of laws on Mr. William Marconi; its doctorate of science on Mr. Francis Darwin and Mr. J. L. Todd and its doctorate of engineering on the Hon. C. A. Parsons.

THE universities of Oxford and of Cambridge have conferred the degree of D.Sc. on Dr. Sven Hedin.

THE seventieth birthday of Dr. G. Lunge, professor of chemistry at Zurich, will be celebrated on September 15.

DR. DAVID STARR JORDAN, president of the American Association for the Advancement of Science, has appointed the following committee to inquire into the manner and course of publication, distribution and use of publications, of American scientific societies: Franz Boas, chairman; R. S. Woodward; William Trelease; J. McK. Cattell; E. G. Conklin.

MR. A. L. BOWMAN is chairman of a special committee appointed by the American Society of Civil Engineers "to consider and report upon the design, ultimate strength and safe working values of steel columns and struts."

MR. JOHN C. OSTRUP, professor of structural engineering at the Stevens Institute of Technology, has been elected a member of the Institution of Civil Engineers of Great Britain.

MR. W. F. BATTERSBY, of the School of Mines, Kingston, Ontario, has won the prize of one hundred dollars which was offered by Mr. J. B. Tyrrell, of Toronto, for the best collection of minerals made in the Province of Ontario during the past year.

PROFESSOR W. M. DAVIS, of Harvard University, now serving as professor in the University of Berlin, has conducted a geological

excursion of some sixty students through the Wera and Leine Valleys.

SIR RUBERT BOYCE, F.R.S., dean of the Liverpool School of Tropical Medicine, is on behalf of the Colonial Office visiting the West Indies for the purpose of looking into the present methods of dealing with sickness and recommending what can be done to promote the physical welfare of the people.

THE Yale Chapter of Sigma Xi held its annual banquet February 27, following the initiation of the new members. Dr. W. N. Rice, professor of geology at Wesleyan University and holder of the first doctor's degree awarded by Yale for study in geology, delivered the formal address of the evening. He spoke on "The Return to Faith," discussing the newer relation of science to religion. Other speakers were Professor Ross G. Harrison; Professor William Hallock, of Columbia University; Professor Charles W. Brown, of Brown University; Assistant Professor R. C. Hawley, '04F., Davenport Hocker, '08, and F. L. Gates, '09.

AT the meeting of the Chicago Section of the American Mathematical Society, the following officers were elected: G. A. Miller, University of Illinois, *chairman;* H. E. Slaught, University of Chicago, *secretary;* O. D. Kellogg, University of Missouri, *member of the program committee.* The next meeting of the section will be held at the University of Chicago on April 10 and 11.

AT the annual meeting of the Physical Society, London, the following officers were elected: *President,* Dr. C. Chree; *vice-presidents,* those who have filled the office of president, together with Mr. W. Duddell, Professor A. Schuster, Mr. S. Skinner and Dr. W. Watson; *secretaries,* Mr. W. R. Cooper and Dr. S. W. J. Smith; *foreign secretary,* Professor S. P. Thompson; *treasurer,* Professor H. L. Callendar; *librarian,* Dr. W. Watson.

AT the anniversary meeting of the Geological Society of London, the officers were elected as follows: *President,* Professor W. J. Sollas; *vice-presidents,* Mr. G. W. Lamplugh, Mr. H. W. Monckton, Dr. J. J. H. Teall and Professor W. W. Watts; *secretaries,* Professor E. J. Garwood and Dr. A. Smith Woodward; *foreign secretary,* Sir Archibald Geikie; *treasurer,* Dr. Aubrey Strahan.

THE Congress on Tropical Diseases, which was opened at Bombay on February 22, was attended by representatives of all parts of India and by Major Ronald Ross, of Liverpool, Professor Shiga, of Japan, and Dr. Musgrave, of the Philippines. The congress is accompanied by a popular medical exhibition.

DR. FREDERICK W. TAYLOR, past-president of the American Society of Mechanical Engineers, gave an address before the College of Engineering of the University of Illinois on February 18.

PROFESSOR CHARLES L. EDWARDS, of Trinity College, will address the Scientific Society of Stamford, Conn., on March 12, on the subject of "The Methods and Results of Deep-sea Exploration."

DR. GEORGE GRANT MACCURDY, of Yale University, gave a lecture before the Buffalo Society of Natural Sciences on February 26, his subject being "The Ancient Art of Chiriqui."

A MEMORIAL has just been erected in Kensington Cemetery, London, to the memory of Admiral Sir Francis Leopold McClintock, the Arctic explorer and discoverer of the lost Franklin expedition. It takes the form of an old style wheel cross standing on a massive molded base, reaching to a height of 10 feet and executed in rough silver-gray Cornish granite.

DR. JAMES W. MOORE, professor of physics in Lafayette College since 1872, died on February 28, at the age of sixty-four years.

SIR GEORGE KING, F.R.S., eminent for his researches on the flora of India, died on February 13, at the age of sixty-eight years.

DR. DAVID JAMES HAMILTON, lately professor of pathology at Aberdeen University and eminent as a pathologist, died on February 19, in Aberdeen, at the age of 60.

A GOVERNMENT laboratory of bacteriology has been founded in Warsaw. The director is Dr. Tscharnozky. The laboratory is in-

tended chiefly for the purposes of veterinary and public health researches.

THE University of Heidelberg has received from a foreign benefactor interested in the advancement of science the sum of over $30,000 towards the foundation of a radiographic institute.

DR. FRANCIS ELGAR, F.R.S., the naval architect, who died on January 17, aged sixty-three, left an estate of the value of £80,000. The testator left £1,600 to the Institution of Naval Architects for the endowment of a scholarship. After making other bequests, he left half of the residue of his property (which will apparently amount to about £33,000), subject to the interest of his wife during widowhood, as to one half to the Institution of Naval Architects for the encouragement of the science and art of naval architecture, and one half to the University of Glasgow, to be held upon trust for the furtherance of the objects of the John Elder chair of naval architecture in that university.

A BALLOT of the proprietors of the London Institution on the proposed amalgamation with the Royal Society of Arts has been taken and resulted as follows: For amalgamation, 322; against, 218. The proprietors, of whom there are 850, were asked to say whether they approved of the drafting of an act of parliament for the amalgamation of the two institutions on the lines of the scheme which was drawn up by the joint committee in 1905. In a preliminary postcard poll 524 voted in favor of the proposal and only 84 against it.

OFFICIAL information has been received by the U. S. Bureau of Education at Washington that an International Musical Congress will be held at Vienna at the end of May, 1909, in connection with the centennial celebration of the birth of Josef Haydn, the composer. A desire has been expressed that the United States should be represented in this congress.

AN International Exhibition of Hygiene will be held at Turin during September, October and November.

WE learn from the *British Medical Journal* that the second International Conference on Leprosy will be held this year at Bergen from August 16 to 19. The preliminary program includes the following subjects: The geographical distribution of leprosy; the forms and diagnosis of the disease; its causes and manner of propagation; its pathological anatomy, and its treatment. The conference will be held under the patronage of the Norwegian Government and King Haakon. The president will be Dr. G. Armauer Hansen, discoverer of the *Bacillus lepræ*. The vice-president is Professor C. Boeck, of the University of Christiania, another recognized authority on leprosy. The secretary is Dr. H. P. Lie, of Bergen, to whom all communications relative to the congress should be addressed.

WE learn from the London *Times* that at a meeting of the joint organizing committee of the International Congress of Applied Chemistry, held in the rooms of the Chemical Society at Burlington House, the secretary presented a report giving details of the progress made since the last meeting of the committee in June, 1908. It was stated that £4,400 had been received in response to a special appeal issued in December. The government was stated to be considering the question of defraying the cost of the South Kensington group of buildings, belonging to the University of London, for the meetings of the congress. Several members of the government have accepted the offices of honorary vice-presidents of the congress, including Lord Morley (Secretary of State for India) and Mr. Haldane (Secretary of State for War). The Society of Chemical Industry, which numbers over 4,000 members, has arranged to hold its annual meeting for 1909 in London on May 26, the day preceding that of the opening of the congress, and the London members of this society have also arranged to entertain the members of the congress on the evening of May 29. Foreign and colonial governments, and the leading scientific and technical societies, have been asked to appoint delegates to represent them at the congress. These delegates will rank as honorary and as ordinary members of the congress respectively.

UNIVERSITY AND EDUCATIONAL NEWS

By action of the corporation the chair of the theory and practise of medicine at Yale University will hereafter be known as the John Slade Ely professorship of the theory and practise of medicine. This action was made possible by the gift to the university of $50,000 by an unknown donor for the purpose of establishing a memorial to Professor Ely, '81S., who filled this chair from 1897 until his death, February 7, 1906. Dr. George Blumer at present holds this professorship.

It is announced that Hamilton College will receive a bequest of $50,000 from Mrs. Annie P. Burgess, of New York City, who died about three years ago, leaving for educational and charitable purposes upward of $200,000. This included $10,000 to Columbia University and to Barnard College for scholarships. After making some other specific bequests she left the remainder of her estate to Hamilton College, Columbia University and Barnard College.

Among the bequests left by the late Mrs. Emma Cummings, of East Hampton, L. I., are $25,000 to Dartmouth College and $25,000 to Bowdoin College.

The late Dr. Charles H. Roberts, of Highland, N. J., in his will provided for the founding of five scholarships of $240 annually at Cornell University.

Harvard University has received a gift of $150,000 for the endowment of the University Chapel. The fund is to be known as the Edward Wigglesworth Memorial Fund.

Maryville College, Tennessee, has secured an endowment of $227,000, of which $50,000 is from the General Educational Board and $50,000 from Mr. Andrew Carnegie.

The University of Michigan has acquired by gift of an alumnus, and from the city of Ann Arbor, a tract of land of about ninety acres to serve as a botanical garden and arboretum. This land has an exceptional variety of soil, elevation and exposure, including a border of over one half mile on the Huron River, easily accessible from the campus. The Woman's League of the university has purchased a seven-acre tract of land, convenient of access, which will be developed as an athletic field for the women of the university. Another gift is of about fifteen hundred acres of land, lying along the shores of Douglas lake in Cheboygan county. This land will serve as the site for the summer engineering camp, and its topography, including forest and open, land and water, various elevations, etc., is well adapted to the purpose. In honor of the donor it has been named The Bogardus Engineering Camp.

Mrs. S. T. Robinson, of Lawrence, Kansas, is offering an opportunity to all women who graduate from the science department of the University of Kansas to do research work in connection with the research table supported by her in the Marine Biological Laboratory at Woods Hole.

The Russian government has decided to establish a new university at Saratoff, and the duty of organizing it has been entrusted to Dr. Rasumowsky, professor of surgery at Kasan.

Governor Draper, of Massachusetts, has appointed Mr. Frederick P. Fish, of Brookline, to be a member of the State Board of Education, to succeed the late Carroll D. Wright. Mr. Fish is a member of the board of overseers of Harvard College and a member of the corporation and executive committee of the Massachusetts Institute of Technology.

DISCUSSION AND CORRESPONDENCE

THE MISSISSIPPI CHANNEL BOTTOM AND GULF LEVEL

To the Editor of Science: The remarkably slight elevation above the sea of the lower flood plains of large rivers like the Mississippi, the Ganges and the Amazon is a matter of frequent comment. The facts are often put rather strikingly by saying that at St. Louis, 1,250 miles by river from the sea, the valley flat is but 400 feet above sea level; at Memphis, 842 miles from the sea, 220 feet; and at Vicksburg, 472 miles from the sea, 90 feet. The same fact is commonly expressed

in terms of the gradient of the river. The Mississippi has a gradient of a few inches per mile from Cairo to the gulf; while the Amazon, rapidly aggrading its flood plain and still quite under the dominion of the waste delivered to it, has, according to the best barometric determinations, an average gradient for the last 500 miles of only one eighth of an inch per mile![1] Barometic determinations are notably unreliable, but errors are at a minimum near sea level in the tropics and this value may be taken as indicative of at least the order of magnitude of the river gradient. The Nile has now been carefully measured by an almost complete line of leveling from Victoria Nyanza to the Mediterranean, a distance of 3,500 miles. It offers a similar set of conditions in its flattest part between Sorbat and Khartum, where the slope has been reliably determined to be from one half to one third of an inch per mile.[2] More striking is the statement of elevation in terms of channel bottom: "the bottom of the channel of the Mississippi is as much as 100 feet below the level of the gulf some 20 miles above New Orleans."[3]

It occurred to the writers that in the case of the Mississippi a possibly still more striking form of expression is that which refers the elevations of channel bottom to sea level, thus arriving at an upstream point where the plane of sea level intersects the channel bottom. The distance of this intersection from the sea or the river mouth is a very striking value indeed. The detailed results of our map examination are expressed in the following table which is compiled from the charts of the Mississippi River Commission based on the surveys of the period 1879–1884. The table shows the maximum depressions and elevations of the channel bottom that occur on each chart, the location of each point (referred to a station usually near some town or landing), together with its distance from the gulf. It will be observed that the first upstream point at which the channel bottom attains gulf level is 388 miles by river from the gulf. The most northerly point at which the bottom occurs at gulf level is 181 miles farther up the river, or 569 miles from the gulf! Here in a narrow and extremely sharp bend the channel reaches a depth of 135 feet, or more than the elevation of the surface of the stream above gulf level at this point.

Chart No.	Maximum Elevation of Channel Bottom above Gulf Level[4]	Minimum Elevation of Channel Bottom above Gulf Level[4]	Location	Miles from Gulf (Cairo = 1072)
55	0		1 mile below Lake St. John Landing	388
		—80	1 mile below Giles Landing	374
54	— 5		7 miles below Coles Creek Landing	393
		—61	2 miles below Coles Creek Landing	398
53	+10		3 miles below Buena Vista Landing	409
		—55	6 miles above Buena Vista Landing	418
52	+10		2 miles above St. Joseph	425
		—60	1 mile below St. Joseph	422
51	+37		1 mile below Grand Gulf Landing	435
		—33	10 miles above Grand Gulf Landing	446
50	+12		2 miles above New Town Landing	455
		—12	6 miles below New Town Landing	447
49	+30		2 miles above Warrentown	467
		—30	4 miles above Warrentown	469
48	+22		4 miles below Vicksburg	479
		—54	1 mile below Vicksburg	482
47	+33		5.5 miles below Milliken's Bend Landing	486
		—32	1 mile above Milliken's Bend Landing	492
46	+37		4 miles above Villa Vista Landing	503
		—26	At Villa Vista Landing	498
45	+44		7 miles below Arcadia Landing	505
		—21	4 miles below Arcadia Landing	508
44	+53		1 mile below Shepard Landing	525
		—10	1 mile above Shepard Landing	528
43	+61		6 miles above Nelson Point Landing	547
		— 6	0.5 mile above Nelson Point Landing	541
42	+51		0.5 mile above Carolina Landing	555
		—26	5 miles below Carolina Landing	550
41	+64		2.5 miles above Lake Washington Landing	569
		—29	4 miles below Lake Washington Landing	563

ISAIAH BOWMAN
C. F. GRAHAM

YALE UNIVERSITY

[1] Colonel G. E. Church, "South America: An Outline of its Physical Geography," *Geog. Journ.*, Vol. 17, 1901, p. 382.

[2] Reported in a paper on the longitudinal section of the river delivered at the 1908 meeting of the British Association and noted in *Nature*, October 15, 1908, p. 617.

[3] Chamberlain and Salisbury, "Geology," Vol. 1, p. 162.

[4] Elevations have been referred to sea level by computations based on the relation of the datum plane for each sheet to gulf level at Biloxi, Miss.

THE NAMING OF NEW SPECIES

TO THE EDITOR OF SCIENCE: The volume of *Proceedings* of the United States National Museum for 1908 has just come to hand with its usual wealth of zoological literature, much of which is naturally of a systematic character. As I have looked through the various articles, and have noted the large number of new species described, I have been struck by the very considerable proportion of names given "in honor of" somebody, or derived from a geographical or geological locality. In other words, the percentage of specific names which are in any sense descriptive or suggestive to a fellow-worker in the same group, is very small, and I am therefore moved to call the attention of systematic zoologists (including, of course, the paleontologists) to what seems to me a very unfortunate tendency among us. The naming of an animal "in honor of" some one has much to recommend it from the personal point of view, if we agree not to debate the question whether it *is* an honor to have a parasitic worm, a skunk or some other unlovable creature named in one's honor. But from the scientific point of view, the custom of using personal names for the designation of particular animals has little to commend it, except possibly where the name of some preeminently great master of a field may be perpetuated in connection with the group upon which he worked; something may be said in favor of *darwini* as the name of a cirriped. The use of names derived from localities or geological horizons has more to recommend it, for such names may be, and often are, suggestive and distinctive. But they are very apt to be shown, by further advances of knowledge, to be not only inapplicable, but oftentimes misleading, and they should only be used where there is little chance for blunders. It seems to me a great pity that we can not return to the original idea for a specific name, that it should be in some sense descriptive. Of course it must be admitted that many names of this class are very misleading, but that fact should only make us more careful in the selection of the names we give. Many zoologists do not realize what the situation really is and I therefore wish to give an analysis of the papers in the volume of *Proceedings* before me.

There are 30 articles in which new species are described, 24 of which deal wholly with recent, and 6 with fossil, species. In the thirty articles 223 new names are proposed for species, besides a number of varieties and subspecies which I have left out of the account. Of the 223 names, 130, or 58 per cent., are in some degree descriptive; 47, or 21 per cent., are names of persons; 45, or nearly 21 per cent., are locality names, and 1 is of doubtful significance.

Of course the 130 names are not all equally descriptive, some are very doubtfully so. The 45 locality names include names derived from geological horizons. The 47 names of persons include 40 individuals, one of whom is honored (?) no less than three times. When it is realized that this honor (?) is sometimes actually asked for, directly or indirectly, it may be seen how very dubious it is. Of the forty individuals, I can count but nine whose scientific attainments can fairly be said to warrant their being chosen; others, of course, would differ from me in the count, but I think no one would find twenty.

Among the thirty papers, some are notably free from the evils I am pointing out. Mr. A. H. Clark's papers on Crinoids include 29 names, of which at least 86 per cent. are descriptive (the derivation of *komachi* is beyond me, so I have not called it descriptive) and Mr. William Warren's paper on geometrid moths includes 34 names of which 94 per cent. are descriptive. Deducting these papers, we find that of 160 names, 73, or less than 46 per cent., are descriptive; 43, or 27 per cent., are personal, and 44, or more than 27 per cent., are locality names.

But Professor Nutting's report on Hawaiian Alcyonaria includes 38 names, of which nearly 77 per cent. are descriptive (8 are personal), and if we deduct these names, we find that of the remaining 122 names, 44, or only 36 per cent., are descriptive; 35, or 28½ per cent., are personal, and 43, or 35½ per cent., are locality names.

Examination of the remaining papers reveals the fact that the paleontological writers pay the least attention to descriptive names, for in their six papers, we find that of 59 proposed specific names 5, or less than 10 per cent., are descriptive; 23, or 38 per cent., are personal, and 31, or over 52 per cent., are locality names.

It would be uncharitable, if it were not quite uncalled for, to suggest either of the two most obvious reasons why an author, particularly a young or inexperienced writer, selects personal or locality names for his new species. But I can not avoid the feeling that these reasons occur to our fellow workers in the other fields of zoology, and may have something to do with the feeling, which it is often said they hold, that we systematists are engaged in a lower grade of work than that with which they are occupied.

HUBERT LYMAN CLARK
MUSEUM OF COMPARATIVE ZOOLOGY,
CAMBRIDGE, MASS.,
January 20, 1909

THE 6-INCH TRANSIT CIRCLE OF THE U. S. NAVAL OBSERVATORY

TO THE EDITOR OF SCIENCE: The following paragraph, which is an essential feature of a paper read by me before Section A, American Association for the Advancement of Science, in Baltimore on December 28, 1908, has been omitted from the abstract of that paper printed in SCIENCE for January 22, p. 154:

"It having been found that the instrument had suffered some damage from gradual deterioration during the five years that it had been out of use, the axis tube and circles and various other parts were sent to Warner & Swasey for repairs with a view to put the instrument in condition to do the fundamental work for which it was originally intended. This work is now nearly finished and the axis and some other parts of the instrument have been returned to the observatory. The pivots have been reground with great care, and elaborate tests have shown them to be very regular in shape and so nearly equal in size that the difference is inappreciable. It is hoped that the remaining parts of the instrument will be returned to us in a few days, in which case measures will be taken immediately to mount the instrument and commence the work of investigation and observation."

MILTON UPDEGRAFF

SCIENTIFIC BOOKS

Resultats du voyage du S. Y. Belgica en 1897, 1898, 1899, sous the commandement de A. de Gerlache de Gomery. Rapports Scientifiques. *Oceanography,* par HENRYK ARCTOWSKI et HUGH ROBERT MILL, 1908. *Physique du Globe,* mesures pendulaires, par G. LECOINTE, 1907. *Zoologie: Turbellarien,* von LUDWIG BÖHMIG, 1908. *Scaphopoden,* von L. PLATE, 1908. *Pennatuliden,* von HECTOR F. E. JUNGERSEN, 1907. *Cirripedia,* by P. P. C. HOEK, 1907. *Geologie:* Glaciers, par HENRYK ARCTOWSKI, 1908.

The reports of the *Belgica* expedition continue to appear, each adding to our knowledge of the Antarctic, its conditions or its fauna. The numbers of which the titles are summarized above are not less interesting than those which preceded them. Space permits but a brief account of their contents.

The soundings and serial temperatures of the sea water taken by the *Belgica* were the first in that region to be observed and corrected by the most modern instruments and methods. Two conclusions are of especial interest. The observations showed that the deeper waters of the Atlantic and Pacific are practically separated by submarine ridges which, extending from the southern end of the American continent to the Antarctic lands, present a barrier to the free circulation of the waters in question. Secondly, it is proved that the surface water of the sea is cooled by the low Antarctic air-temperatures and by floating and melting ice, below which is a warmer stratum which reaches its maximum temperature two or three hundred fathoms below the surface, after which the temperature gradually diminishes until the bottom of the sea is reached. The persistency of the warmer stratum indicates the slowness of changes due to convection, and the existence of currents

by which the warmer waters from the north replace the colder upper stratum which moves from the south. The temperatures naturally have a very narrow range, comprised within ten degrees of the point (28° F.) where sea water freezes.

The report on the pendulum observations is preceded by a short and pathetic account of the life and services of Lieutenant E. Danco, who died on the *Belgica*, at the age of twenty-nine years and to whom these observations had been confided. A fine portrait of Danco accompanies the notice. The work was carried on subsequently by Lecointe, but owing to a variety of circumstances the value of gravity was obtained by the expedition only at Punta Arenas in the Straits of Magellan.

In his discussion of the glaciers and bergs Arctowski considers first those of Tierra del Fuego, and secondly those of Gerlache Bay and the Antarctic lands. He concludes that the mountainous region of both was once continuous, the geology indicating much the same characteristics. He also contrasts the effect of the ice cap where incomplete and broken by nunataks, and when existing as a continuous covering extending to the sea level. In the latter case and for Antarctica generally he is disposed to believe that the ice is exercising a comparatively small abrasive function, and that its effect on the subjacent rock is very slight at present, the glacial streams being clear instead of milky and rock forms exposed by the retreating ice rounded off rather than channeled or excavated. This memoir is illustrated by numerous excellent half-tone plates derived from photographs.

The report on the barnacles considers a few Magellanic forms and one new truly Antarctic species, *Verruca mitra*, obtained in some 250 fathoms in south latitude 70°. Only one strictly Antarctic species was previously known, the *Scalpellum antarcticum* Hoek, obtained by the *Challenger*.

Only one species of Pennatulidæ was obtained on the expedition. This belongs to the genus *Umbellula* first described from the Polar Sea by Ellis from a dry specimen obtained in 1758. The *Belgica* species is *U. carpenteri* Kölliker, first obtained by the *Challenger*. Two other species are known from the Antarctic, of which one is so close to the Arctic *U. encrinus* of Linné as to be regarded by Kölliker as the same species.

Only two scaphopods were recognized by Plate in the collection, from south of latitude 70° S. One is referred to the *Dentalium majorinum* of Mabille and Rochebrune, variety *gaussianum*, previously described from material obtained by the Gauss expedition. The other, though probably a distinct species, was not sufficiently perfect for description.

The turbellarians comprised a new genus and species of Acoela, *Rimicola glacialis* Böhmig, and three species of Tricladida, of which one, *Procerodes hallezi*, is described as new. The latter is Fuegian, having been dredged in Beagle Channel. A new genus and subfamily are described to include *Procerodes* (now *Stummeria*) *marginata* Haller. The forms discussed are anatomically described and figured in great detail.

Wm. H. Dall

A Text-book of Mechanical Drawing and Elementary Machine Design. By John S. Reid, Professor of Mechanical Drawing and Designing, Armour Institute, and David Reid, formerly Instructor in Mechanical Drawing and Designing, Sibley College, Cornell University. Revised edition, enlarged. Pp. xi + 433. New York, John Wiley & Sons. 1908.

It would be difficult, in fact practically impossible, to compress within equal limits more of service to the student of machine design who wished at the same time to qualify as a draftsman. Not only are all necessary proportions and tables given for the designing of screws, nuts, bolts, keys, cotters and gibs, riveted joints, shafting, pipes and couplings, bearings, belt and toothed gearing, valves and general engine details, but there are also full data for drafting courses, with the unusual feature of time-allotment included, securing the early attainment by the novice of a commercial rate of speed in his work.

As indicative of the methods and procedure in one of the leading technical schools the book is of especial interest to teachers of

drafting; while the student who must, by force of circumstances, be self-instructed, could not be better provided therefor.

The treatment of valve-motion is admirable. The precedence given the Bilgram diagram over the Zeuner, although unusual, is fully warranted, the former being far superior for designing, while possessing equal merits with the latter for analysis.

The frequent shaded perspectives will be especially appreciated by the beginner in machine drawing, obviating, as they do, in considerable degree, the necessity for the models recommended but not always obtainable.

Among the more important features appearing for the first time in this edition are the "Course in Lettering" and the "Present Practise in Drafting Room Methods," the latter a summary of replies, from two hundred of the leading engineering firms of this country, to thirty-five questions as to shop practise. An ample index completes this altogether valuable work.

FREDERICK N. WILLSON

SCIENTIFIC JOURNALS AND ARTICLES

THE February number (volume 15, number 5) of the *Bulletin of the American Mathematical Society* contains the following papers: "The Second Regular Meeting of the Southwestern Section," by O. D. Kellogg; "Remarks Concerning the Second Variation for Isoperimetric Problems," by Oskar Bolza; "Notes on the Simplex Theory of Numbers," by R. D. Carmichael; "The Solution of Boundary Problems of Linear Differential Equations of Odd Order," by W. D. A. Westfall; "A Class of Functions Having a Peculiar Discontinuity," by W. D. A. Westfall; "On Certain Determinants Connected with a Problem in Celestial Mechanics," by H. E. Buchanan; "Sylvester's Mathematical Papers," by L. E. Dickson; "Hilton's Finite Groups," by Arthur Ranum; "Shorter Notices": Ball-Freund's Histoire des Mathématiques, and Günther's Geschichte der Mathematik, by D. E. Smith; Tannery's Manuscrits de Evariste Galois and Minkowski's Diophantische Approximationen, by L. E. Dickson; Sturm's Lehre von den geometrischen Verwandtschaften, Band II., by Virgil Snyder; Arnoux's Arithmétique graphique, by W. H. Bussey; Enriques-Fleischer's Fragen der Elementargeometrie, by H. E. Hawkes; Poincaré's Leçons de Mécanique celeste, by F. R. Moulton; Gutzmer Tätigkeit der Unterrichtskommission, by J. W. A. Young; "Notes"; "New Publications."

The March number of the *Bulletin* contains: "The Fifteenth Annual Meeting of the American Mathematical Society," by F. N. Cole; "The Winter Meeting of the Chicago Section," by H. E. Slaught; "The Sixteenth Meeting of the American Association for the Advancement of Science," by G. A. Miller; "Some Surfaces Having a Family of Helices as One Set of Lines of Curvature," by Eva M. Smith; "Note on Enriques's Review of the Foundations of Geometry," by A. R. Schweitzer; "Notes"; "New Publications."

SPECIAL ARTICLES

A POSSIBLE ERROR IN THE ESTIMATES OF THE RATE OF GEOLOGIC DENUDATION[1]

THE presentation at the Baltimore meeting of the American Chemical Society of a paper by Dole and Stabler on the rapidity of geologic denudation recalls attention to a possible source of error in such estimates which has been already implied in the writings of Walther, Udden and other students of æolian geology. The peculiarly thorough and comprehensive figures of Dole and Stabler are deduced, as have been all previous ones, from the examination of river waters, and are based upon the assumption that all material which is removed from the land to the sea is carried in suspension or solution by outward-flowing water. Recent studies on the magnitude of æolian transport cast some doubt upon the validity of this assumption. It has become apparent that much surface material is moved from place to place by æolian action and that much of this transport is to be ascribed to the slow and unnoticed, but continuous, action of

[1] Published by permission of the Secretary of Agriculture.

ordinary winds. The winds are so ubiquitous and so incessantly in motion that their aggregate geologic work is by no means negligible, though it may be momentarily inappreciable. If the winds are constantly carrying material they must be carrying some of it to sea, and of this the major part will be deposited in the ocean and only a small fraction returned to the land. Land breezes are notoriously dusty, and that the winds blowing inward from the ocean are much more free from solid contamination is known, not only deductively and from general observation, but as the result of actual counts of the dust particles.[2]

Udden[3] has calculated on very conservative data that the transport capacity of the winds blowing outward from the Mississippi Basin is at least one thousand times greater than that of the river. This, of course, refers only to transport *capacity*, and no one imagines that the actual amounts of material moved are in the same ratio. The air, unlike the water, is seldom loaded to any considerable fraction of its capacity. It is evident, however, that if the wind performs only an infinitesimal part of the carriage for which it has the ability, its activity is nevertheless far too great to be neglected. Neither is the Mississippi Basin a region especially susceptible to æolian action. The immense amount of wind-borne material carried out of deserts is universally admitted, and the example of the sirocco dust which constantly leaves the Sahara for the Atlantic to the west and the Mediterranean to the north is universally familiar.

From the information at present available it is entirely impossible to estimate with accuracy the yearly rate of æolian removal or the resultant error in the calculations of the rapidity of denudation. It seems, however, not improbable that the error is of some moment and that the present estimates are too low in a not unimportant degree, even when their admittedly approximate character is taken into account. These conclusions derive added force from two recent papers by Thoulet[4] in which he records his conviction that a considerable fraction of the mud of the sea bottom is terrestrial dust borne to its position by winds and fallen through the overlying water in an approximately vertical path.

E. E. Free

Bureau of Soils,
U. S. Department of Agriculture

[2] Aitkin, *Trans. Roy. Soc. Edinb.*, 42: 486, 1902.

[3] *Jour. Geol.*, 2: 318–331, 1894.

[4] *Comptes Rendus*, 146: 1184–1186, 1346–1349, 1908.

THE AMERICAN SOCIETY OF ZOOLOGISTS

The regular triennial joint meeting of the Eastern and Central Branches of the American Society of Zoologists was held at the Johns Hopkins University, Baltimore, Md., on December 29, 30 and 31, 1908.

The following resolutions were adopted:

Resolved, That this society most urgently recommends to the Committee on Ways and Means, or other body having the matter in charge, that the present duty on scientific books published in English, and on scientific apparatus be removed.

Resolved, That, in the opinion of this society, the migratory birds of the United States should be properly protected by national laws, and that this society urges immediate consideration of the bill, introduced by Representative Weeks, now before Congress.

The officers elected were:

EASTERN BRANCH

President—Herbert S. Jennings, Johns Hopkins University.

Vice-president—H. V. Wilson, University of North Carolina.

Secretary-Treasurer—Lorande Loss Woodruff, Yale University.

Additional Member of Executive Committee—Maynard M. Metcalf, Oberlin College.

CENTRAL BRANCH

President—Edward A. Birge, University of Wisconsin.

Vice-president—Michael F. Guyer, University of Cincinnati.

Secretary-Treasurer—Charles Zeleny, University of Indiana.

The following papers were presented:

Diverse Races of Paramecium and their Relation to Selection and to Conjugation: H. S. Jennings, Johns Hopkins University.

"Wild" cultures of *Parameoium* were found to consist of many diverse races, which remain constant in relative mean size when propagated in "pure lines," by fission. Eight such differing "pure lines" were isolated and propagated side by side under the same conditions for many months. The smallest race had a mean length below 100 microns; the largest a mean length above 200 microns. Most existing races fall into two groups: (1) those with mean length above 170 microns; (2) those with mean below 140 microns. The former group corresponds to what has been described as the species *caudatum*, the latter to *aurelia*. A single race falling half-way between the two groups was found; such races are rare.

Within the pure race there is much variation due to environmental conditions and to growth, but such variations are not inherited. Large and small individuals of the same race produce progeny of the same mean size, so that the characteristics of the progeny depend on the fundamental constitution of the race, not on the individual peculiarities of the parent. It is not possible to produce by long continued selection diverse races from a single race.

The diverse races retain their relative sizes throughout the life cycle, including conjugation. Owing to the assortative mating described by Pearl, there is a tendency for the diverse races to remain isolated even when conjugation occurs.

The Reactions of Didinium nasutum with Special Reference to the Feeding Habits and the Functions of Trichocysts: S. O. MAST, Woman's College of Baltimore.

Light Reactions in Euglena and Stentor cœruleus: S. O. MAST, Woman's College of Baltimore.

Notes on Opalina: MAYNARD M. METCALF, Oberlin College.

A paper describing the phenomena to which these notes refer will appear in the *Archiv f. Protistenkunde*, Bd. XIII., Heft 3.

The Measurement of Relative Toxicity and of Differences of Physiological State by the Use of Protozoa: A. W. PETERS, University of Illinois.

Selection of Food in Stentor cœruleus: ASA A. SCHAEFFER, Johns Hopkins University.

From a capillary pipette, potato starch grains, particles of sand, bits of débris, *Euglena viridis*, *Phacus triqueter*, *Trachelomonas volvocina*, etc., were fed in mixed order, on to the disk of a *Stentor*. The path and fate of each particle was recorded. The starch, sand and débris were almost invariably rejected, while the organisms, either freshly killed or living, were invariably ingested. When the *Stentor* became more and more filled up, more and more of the organisms were rejected, until eventually all organisms, as well as all starch, sand, etc., were rejected.

In some experiments it was shown that some organisms are eaten while others are not; thus in a stream of *Euglena viridis* and *Trachelomonas volvocina*, fed in mixed order, although both kinds of organisms were eaten at the beginning of the experiment, the *Stentor* ate only *Euglena* in the latter part of the experiment, rejecting all *Trachelomonas* and also some *Euglena*.

Thus *Stentor* can "select" food particles from a stream containing food and non-food particles. Further, *Stentor* can "select" one kind of food from a mixture of several different kinds, such as *Euglena* from *Trachelomonas*, etc.; and it is highly probable that *Stentor*, when nearly replete, "selects" certain individuals to the exclusion of others, of the same species.

Selection can be explained upon purely objective grounds as determined by the action of the stimulus in the particle upon the ingesting mechanism (including the varying physiologic state) of *Stentor*.

Duration of the Cycle of Paramecium: LORANDE LOSS WOODRUFF, Yale University.

A culture of *Paramecium* has been carried on a varied culture medium for twenty months, during which time 930 generations have been attained. Conjugation has been prevented by the daily isolation of individuals, and no artificial stimulation has been employed. "Abnormal" physiological or morphological changes have not appeared in the specimens.

Effects of Centrifugal Force on the Organization and Development of the Eggs of Ascidians and Mollusks: E. G. CONKLIN, Princeton University.

The Organization of the Egg of a Medusa: E. G. CONKLIN, Princeton University.

The Oogenesis of Cumingia tellinoides (Conrad): H. E. JORDAN, University of Virginia.

The primary oocyte at the beginning of the growth period has a nucleus of three microns diameter. The nuclear reticulum is achromatic except for a large eccentric nucleolus. At slightly later stages chromatic masses appear in the nucleus and are generally arranged in pairs. Such pairs probably represent presynoptic bivalent chromosomes. The arrangement of the chromosomes indicates parasynapsis. Still later in the

growth period the chromosomes become aggregated into a mass and the latter assumes a more or less close connection with the nucleolus. Both nucleolus and chromosome-mass are typically close to the nuclear wall. Maturation proceeds to the metaphase in the ovarian egg. A single instance was observed where the mitosis had passed to anaphase. The later phases of maturation occur only after the egg is extruded and fertilized. The nucleolus disappears during the metaphase of the first maturation mitosis. It seems to contribute a small amount of chromatin to the chromosomes, after which its main bulk is resorbed by the cytoplasm. The nucleolus appears to be of the nature of reserve food material rather than a waste product.

The astral system of the first mitosis consists of a large, very chromatic centrosome surrounded by a homogeneous acroplasmic centrosphere which is bounded by a "microsome circle" and an outlying astrosphere. Between metaphase and anaphase in the free eggs the centrosome disappears. The centrosphere of the second polar spindle, as also of the fertilization and early segmentation spindles, is achromatic and granular. The centrosome appears to be merely an accompaniment of the astral system, representing a transient metabolic phase of maturation coincident with the formation of the first polar spindle. The reduced number of chromosomes is eighteen. The second mitosis segments univalent chromosomes transversely and is the reducing division.

The Germ-cell Determinants of Chrysomelid Beetles: R. W. Hegner, University of Michigan.

The Germ-cell Determinants.—This paper is based on the study of the lineage of the germ-cells of *Calligrapha multipunctata* and three other chrysomelid beetles. At the time of laying a disc-shaped mass of granules is present at the posterior end of the egg suspended in the peripheral layer of cytoplasm. I have called this disc the "pole-disc" and the granules the "germ-cell determinants." The cleavage products in the eggs of these beetles migrate through the central yolk mass to the periphery, where they produce the blastoderm. Those cleavage products that come in contact with the germ-cell determinants do not produce blastoderm cells, but continue their migration until they are entirely separated from the egg. These cells take with them practically all of the germ-cell determinants. At first there are 16 of these cells, but they soon divide twice, the final number being 64. These are the primordial germ-cells. They can be traced back into the embryo, where by amœboid movements they migrate half to either side of the germ-band. Later they produce the germ-glands. The sexes can be distinguished during the embryonic period by the shape of the germ-glands.

The Results of Removing the Germ-cell Determinants.—A number of fresh eggs were punctured and the germ-cell determinants allowed to flow out. These eggs developed into embryos or larvæ which contained no germ-cells.

The Sexual Differences of the Chromosome Groups in Pyrrochoris and Syromastes: Edmund B. Wilson, Columbia University.

The facts in *Pyrrochoris* and *Syromastes* have been supposed to contradict the general rule, established for many other forms, that those spermatozoa which receive the accessory chromosome are female-producing, the others male-producing; for in both cases the two sexes have been described as having the same number of chromosomes—24 in *Pyrrochoris* and 22 in *Syromastes*. A reexamination of both sexes in the two forms has proved that they form no exception to the rule, previously published accounts being erroneous in respect to the male of *Pyrrochoris* and the female of *Syromastes*.

In *Pyrrochoris* the male number is not 24, but 23, the odd or accessory chromosome being the largest of the chromosomes. Half the spermatozoa receive this chromosome and half fail to receive it, the former class having 12 chromosomes and the latter 11. The female groups contain 24 chromosomes, of which two are of the same relative size as the single accessory of the male. *Pyrrochoris*, therefore, conforms precisely to the usual type shown in *Anasa*, *Protenor*, etc.

In *Syromastes* the male number is 22 (as described by Gross), but the female number is not 22, but 24, as was first inferred by the writer from the condition seen in the male only. Direct observation has now proved that this inference was correct. *Syromastes* constitutes a new type in which there are two accessory chromosomes (the second and third smallest of the spermatogonial groups) which pass together, as a bivalent, into half the spermatozoa. These spermatozoa receive 12 chromosomes, the others 10, and the somatic numbers of the sexes prove that the former class are female-producing, the latter male-producing. (Demonstrations by photographs.)

Some New Types of Chromosome Distribution and Their Relation to Sex: Fernandus Payne, Columbia University.

A study of *Gelastocoris* and the Reduviidæ has revealed several new types of chromosome distribution.

There is present in *Diplodus* and several other species of the Reduviidæ a pair of idiochromosomes, which in the new types is replaced by a compound group. Each of these groups as a whole behaves as a pair of idiochromosomes, the small idiochromosome being represented by one element and the large idiochromosome by a multiple group. In *Fitchia* the multiple group consists of two; in *Prionidus*, three; in *Gelastocoris*, four; and in *Acholla multispinosa* (identified by E. P. Van Duzee) of five chromosomes. This multiple group in the second maturation division always passes to one pole and the single element the other, thus producing in each case two classes of spermatozoa.

The male and female chromosome groups are, respectively, 27 and 28 in *Fitchia;* 26 and 28 in *Prionidus;* 35 and 38 in *Gelastocoris;* and 26 and 30 in *Acholla*. Judging from these numerical relations the two classes of spermatozoa must be male and female producing.

It seems very probable that the new types have arisen from the idiochromosome type by the large idiochromosome breaking up into a number of elements.

These new types of chromosome distribution offer nothing new to the theory of sex-production as advocated by Wilson ('06) and Stevens ('06), but they are perfectly consistent with it.

In *Acholla multispinosa,* although the female has the larger number of chromosomes, the male seems to have the greater quantity of chromatin.

Sex Determination and Parthenogenesis in Phylloxerans and Aphids: T. H. Morgan, Columbia University. (See Science, 1909.)

Maturation, Fertilization and Cleavage of Tubularia crocea and Pennaria tiarella: Geo. T. Hargitt.

During the period between the end of the growth of the egg and the formation of the polar bodies the large nucleolus disappears, a concentration of the chromatin occurs, the nucleus decreases in size and becomes ovoid in shape. At the pointed outer end only, in the nucleus of *Tubularia,* an aster without a centrosome is usually present for a considerable time. The fate of this aster is not known.

Polar bodies are formed by mitosis. No asters or centrosomes are present in the first polar spindle, so far the only one actually observed. In *Tubularia* two polar bodies are formed. In the first polar spindle of *Pennaria* apparently only about one half of the somatic number of chromosomes is present, though the actual number is still uncertain. In *Pennaria* the time of formation of the polar bodies varies considerably, some eggs passing through this stage just before fertilization, and some several hours before the liberation of the eggs from the medusæ.

In *Pennaria* spermatozoa may enter the egg at any point, though usually close to the position of the egg nucleus. The transformation into the sperm nucleus takes place just within the edge of the egg, before migration toward the egg nucleus begins. One or both of the pronuclei are often multi-vesiculate, at least up to the time of conjugation. No asters or radiations of any sort are present during the conjugation of the pronuclei.

Segmentation seems to be always by mitosis and cytoplasmic division is often delayed until several nuclei are present.

Early Development of the Spider's Egg: Thos. H. Montgomery, Jr.

The gastrulation takes place from an anterior and a posterior cumulus, and from the margins of the germ disc; vitellocytes form at all these regions, mesoblast and entoblast only from the anterior cumulus. The vitellocytes take no part in producing the intestine. Entoblast develops only in the abdomen. The blood cells arise from the extraembryonic ectoblast, and migrate secondarily into the embryo. One pair of cœlomic sacs develops anterior to the mouth, and the rostral prominences are to be considered prestomial appendages of this head segment; there is no evidence of other preoral appendages. Pulmonary lamellæ appear before the pulmonary appendages invaginate, and upon these. The supraœsophageal ganglion is a fusion of one pair of cerebral ridges, and a pair of antero-lateral and a pair of postero-lateral vesicles, all local differentiations of the single head lobe.

The Formation of the Mouth Opening and the Limits of the Ectoderm and Entoderm in the Mouth of Amphibians: J. B. Johnston.

The Post-anal Gut and its Relation to the Doctrine of Recapitulation: Bashford Dean, Columbia University.

It was pointed out that the general value of the "biogenetic law," now often discredited, might be tested by paleontological documents, even in the case of structures whose nature rendered them poor subjects for fossilization. This Dr. Dean illustrated in the case of the post-anal gut in the embryos of fishes, giving reasons to show that the post-

anal was a functional gut in the adult of certain Devonian sharks. In these forms (Cladoselachids) the anal fin was paired, its elements converging at the base of the tail, where the cloaca was accordingly located. The sub-caudal position of the cloaca is, moreover, indicated by the position of the kidneys. These are now known, both by macroscopic and histological characters in these fossils to have continued behind the ventral fins and converged near the tail.

The Cause of Pulsation in Scyphomedusæ: ALFRED GOLDSBOROUGH MAYER, Carnegie Institution of Washington.

In the case of *Cassiopea xamachana* the sodium chloride of the sea water is a powerful stimulant to the nervous system, but its tendency in this direction is exactly offset and counteracted by the inhibiting influences of the magnesium, calcium and potassium. Thus the sea water as a whole is a balanced fluid, and neither stimulates nor inhibits the pulsation of the medusa.

The stimulus which causes pulsation is due to a slight but constantly maintained excess of sodium chloride over and above its concentration in the sea water. This excess of sodium chloride is engendered in the distal endodermal cells of the marginal sense-organs, which constantly give rise to sodium oxalate. This oxalate precipitates the calcium chloride and sulphate which enter the sense-club from the surrounding sea water, and forms the calcic oxalate crystals of the sense-club, thus setting free sodium chloride and sulphate, which act as powerful nervous stimulants to which the nervous elements respond periodically.

The stimulus-producing pulsation is thus wholly internal, not due to external agencies. It has been commonly supposed that the crystalline concretions in the sense-clubs of scyphomedusæ were calcium carbonate, but I find upon chemical analysis that they are oxalates.

The Sense of Hearing in the Dogfish: G. H. PARKER, Harvard University.

If the side of a large wooden aquarium in which a dogfish (*Mustelus canis*) is swimming quietly is struck a vigorous blow, the dogfish will react by a quivering motion, especially of the posterior edges of the pectoral fins. By the use of a heavy pendulum the momentum with which a given blow was struck could be determined. The momentum of the minimum blow to which normal fishes reacted was arbitrarily called unity. After the eighth nerves were cut a blow with a momentum three or four times that just mentioned was needed to produce a reaction. This response was believed to be due to the mechanical stimulation of the skin. After the skin of a normal fish had been rendered insensitive by cutting the fifth, seventh and lateral line nerves, and by cocaining the pectoral regions, a step not taken in previous experiments, the fish was found to be as sensitive to sounds as a normal fish is. This sensitiveness entirely disappeared when in addition to the operations already carried out on the fish, the eighth nerves were cut. Sounds affect both the skin and the ears of the dogfish and the latter organs are the more sensitive of the two.

Regulation in the Morphogenetic Activity of the Oviduct of the Hen: RAYMOND PEARL, Maine Agricultural Experiment Station.

This paper gives an account of a case in which a gradual change in the shape of eggs successively laid by the same bird occurred. This change in the shape of the eggs is (1) referable to a change in the activity of the oviduct, (2) definitely progressive and (3) regulatory in character, since it proceeds from the abnormal to the normal. The first egg laid by a particular Barred Plymouth Rock pullet (No. 183) was strikingly abnormal in shape (long and narrow). Every egg laid by this bird was saved and measured. As eggs were successively laid there was a gradual change in shape from the abnormal condition found in the first eggs to a substantially normal condition.

The change in the shape of the eggs was found to follow a logarithmic curve, of the type seen in growth curves.

The Nature of the Stimulus which Causes a Shell to be Formed on a Bird's Egg: RAYMOND PEARL and FRANK M. SURFACE, Maine Agricultural Experiment Station.

This investigation was undertaken to determine precisely what is the nature of the stimulus which excites the reflex activity of the shell-secreting glands of the oviduct in birds. These possibilities were to be considered:

1. That the stimulus is mechanical, and arises from the presence of a soft body (the egg) within the "uterus" or "shell gland."

2. That the stimulus is chemical in nature.

3. That the activity of the shell-secreting apparatus is controlled directly by the functioning of other parts of the reproductive system.

If shell formation is caused from the mechanical stimulation of the "shell gland" by the egg it would be expected that any foreign body introduced into that portion of the oviduct would have a shell formed around it. It was found to be impossible to introduce a foreign body of any size

from the outside into the "shell gland" without resort to such violent methods as to make the conditions entirely abnormal. Further, the foreign body introduced should approximate to the consistency of the egg, so that the stimulus may be physiological rather than traumatic.

To realize these conditions the following operation was performed on hens. The oviduct was transected 1 or 2 cm. above the upper end of the "shell gland." The anterior portion of the oviduct was then ligated. The intestine was transected just anterior to the cloaca and the cloacal wall repaired by inversion of the stump and a purse string suture. Then the cut end of the intestine was anastomosed to the cut end of the oviduct ("shell gland"). As a result of this operation the feces must necessarily pass through the "shell gland" on the way to the cloaca. *In hens on which this operation has been performed a calcareous shell is deposited on the feces during their passage through the shell gland.* The results obtained from these experiments are held to warrant the following conclusions:

1. The stimulus which sets the shell-secreting glands of the fowl's oviduct into activity is mechanical rather than chemical in nature.

2. The formation of a shell on the hen's egg is brought about by a strictly local reflex, and is not immediately dependent upon the activity of other portions of the reproductive system (nervous impulse of hormone formation).

Experimental Control of Fission in Planaria: C. M. CHILD, University of Chicago.

The Artificial Production and the Development of One-eyed Monsters: CHARLES R. STOCKARD, Cornell Medical School.

The eggs of the fish, *Fundulus heteroclitus*, give rise to a large percentage of cyclopean embryos when subjected during their development to solutions of magnesium salts in sea water. These one-eyed embryos hatch and many of them swim in a perfectly normal manner, darting back and forth to avoid objects placed in their field of vision as readily as do two-eyed individuals.

The cyclopean fish is entirely comparable to the one-eyed human monsters. Both have a median eye more or less double in structure. The nose in the human cyclops is a proboscis-like mass above the eye. The nasal pits in the "magnesium embryos" are sometimes united and sometimes separate, but the mouth hangs ventrally as a proboscis-like organ, suggesting in form the nose in mammalian cyclopia.

The fish embryos exhibit various degrees of the cyclopean defect from eyes unusually close together to approximated eyes, double eyes and finally a single median eye. The different conditions are exhibited from the earliest appearance of the optic outpushings and in no case was cyclopia due to a union or fusion of the two eye components after they had originated separately.

A second type of monster, "monstrum monopthalmicum asymmetricum," was also common in the magnesium solutions. These individuals have one perfect eye of the normal pair but the other is either small, poorly represented or entirely absent. This condition is also present from the first appearance of eye structures and is not due to degeneration or arrest of development.

Both types of monsters often form well-differentiated crystalline lenses independently of a stimulus from the optic-cup.

The experiments conclusively prove that developing eggs may be induced to form cyclopean monsters by external influences which do not mechanically injure certain eye regions. Therefore, cyclopean monsters in nature are probably not due to germinal variations, but are far more likely the result of some unusual external influence during development.

Cosmobia; a Theory Concerning Certain Types of Monsters: H. H. WILDER, Smith College.

The readiness with which the types of double monsters may be arranged in related series has been recognized for some time, and this phase of the subject has been recently revived. To illustrate this, the main types of the Janus series were presented, beginning with a symmetrical Janus, passing through the different stages of gnathopagus, thoracopagus, etc., and ending with a type of duplicate twins in which the placenta alone is common, the other parts distinct. This leads to the definition of such twins as double monsters in which the common parts are confined to the extra-embryonal structures. These are lost at birth, freeing the components. The diprosopus group was treated in the same way. Attention was then called to the fact that in symmetrical monsters that are less than unity the doubled or compound parts, eyes, limbs, etc., are indistinguishable from those that are found in monsters that are on the other side of the normal, *i. e.*, the diplopagi. As a conclusion from this it seems that both classes of monsters are due to the same or a similar cause, and that normal individuals also belong in the same general series. To such individuals, both less and more than unity, including also normal forms, the term "*cosmobia*,"

or "orderly beings," may be applied. These forms are held to be due to some fundamental cause inherent in the germ itself, that is, in the egg or the embryo in the early cleavage stages, and must be carefully distinguished from all deformities or other monstrosities that are due to external or later developing causes, not germinal.

A Further Contribution on the Regenerative Power of the Somatic Cells of Sponges after Removal from the Parent: H. V. Wilson, University of North Carolina.

I have described (*Journ. Exper. Zool.*, Vol. V., No. 2) a method by which sponges, more particularly *Microciona*, may be made to regenerate from somatic cells. The sponge is cut into pieces and the pieces are strained under pressure through bolting cloth. The separated cells of the body pass through the pores of the cloth and collect as a sediment on the bottom of the dish. The sediment may be drawn up into a pipette and strewn over a glass slide or other object. The cells combine, forming a plasmodial structure which gradually differentiates into a functional sponge having pores, oscula, flagellated chambers and canals. It remained doubtful whether sponges grown in this way would live long enough to develop the characteristic skeleton. The experiments with *Microciona* have been repeated, and the regenerated sponges kept for two months. The characteristic species-skeleton was differentiated. Reproductive elements and embryos were also formed. The sponges appear to be healthy and to differ in no wise from normal specimens.

The Effects of Certain Paralyzing Agents on Form Regulation: C. M. Child, University of Chicago.

The Rate of Regeneration and the Effect of New Tissue on the Old Body: Charles R. Stockard, Cornell Medical School.

Regeneration takes place equally fast from the disk of *Cassiopea xamachana*, whether it be in periodic pulsation or in a condition of rest.

Peripheral pieces of the disk cut in sundry patterns show decided regulatory ability and tend to assume the original circular shape of the entire disk in the most direct way that their forms will permit. The attainment of the circular form inhibits the process of regeneration in the pieces, yet regeneration will continue for a much longer time if such shapes be prevented.

The rate of regeneration from a peripheral cut on the *Cassiopea* disk is faster the nearer the disk center the cut is made. In the brittle-stars *Ophiocoma riisei* and *O. echinata* new arms regenerate faster as the old arms are cut off nearer their base of attachment to the body-disk.

The rate of regeneration does not bear a definite relation to the extent of injury in all animal species. The medusa, *Cassiopea*, regenerates each oral-arm at a rate which is independent of the degree of injury when replacing either one, two, four or six of its arms. If, however, eight arms are amputated each arm regenerates at a rate significantly faster than the rate when injured to any less degree. *Ophiocoma riisei* regenerates one, two, three, four or all five of its arms at rates not significantly different. *O. echinata* grows individual arms fastest when only a single arm is regenerating and successively slower when two, three, four and five arms are being replaced.

Regenerating tissue possesses an excessive capacity for the absorption of nutriment and may do so even to the detriment of the old body tissue. The unfed disk of *Cassiopea* decreases in size in direct relation to the number of regenerating arms. Although the disk regenerating eight new arms is growing them at the most rapid rate, it is, nevertheless, decreasing in size most rapidly. In growing specimens of *Ophiocoma riisei* the increase in size is slower in those individuals regenerating many arms as compared with others regenerating fewer. *O. echinata* regenerates each arm faster when only a few arms are cut, such individuals increase in size at about the same rate as do those which are regenerating each arm slower although more arms are being replaced.

Successive Regenerations; New Observations and General Discussion: Charles Zeleny, University of Indiana.

The Physiology of Nematocysts: O. C. Glaser and C. M. Sparrow, University of Michigan.

Nematocysts, isolated by digestion and maceration, can be discharged by raising their internal pressure.

The pressure needed to bring about explosion varies with conditions. It may be artificially altered by immersion in various liquids, a fact which explains why the nematocysts of eolids explode in sea water, whereas those freshly isolated from cœlenterates, do not.

When stimulated, the nematocyte is a factor in the discharge of the thread. It is not possible to show that stimulation of the mother-cell results from all the conditions under which explosion occurs. Nevertheless, it is probably true that when a nematocyst discharges as the result of conditions normal to the lives of cœlenterates, it

does so because the nematocyte enclosing it has been stimulated.

Elevation of the internal pressure of the nematocyst may be the cause of normal explosion in cœlenterates. If we suppose that stimulation of the nematocyte inaugurates changes which result in lowering the concentration of the cell contents surrounding the nematocysts, the result can be understood. If, as is not unlikely, heat is liberated, the matter becomes still easier, for either dilution or heat can separately bring about the instantaneous discharge of freshly isolated nematocysts.

Distortion brings about the discharge of isolated nematocysts, but uniform external pressure is useless. It might be supposed that inside the nematocyte there is a mechanism capable of squeezing the nematocyst. Such a mechanism is at present purely hypothetical, and, it seems to me, not needed to explain the facts.

The threads of nematocysts, contrary assertions notwithstanding, are able to penetrate the tissues of other animals, but in order to do so must make their punctures during the period of highest speed, viz., at the beginning of the eversion. This observation renders unnecessary the assumption of a "Reizgift," made in order to account for the nettling sensation produced by nematocysts.

The Behavior of the Cuckoo: FRANCIS H. HERRICK, Western Reserve University.

There is no conclusive evidence to show that the American black and yellow-billed cuckoos are either losing their nesting instincts, or that once having lost them they have been regained. Possibly a lack of attunement of the cyclical instincts occasionally seen in all birds, and rather more frequent in these cuckoos, may have been the starting point of the "parasitic" habit of *Cuculus canorus* and related old-world genera. Parental instinct is strong in the American cuckoos, and their nests, though frail, are well adapted to their purposes.

The eggs are commonly laid and hatched on alternate days, but nest-life is not unduly prolonged in consequence, this apparent extension being counterbalanced by the development of a remarkable climbing instinct in the young and a premature desertion of the nest. In the life and behavior of the young cuckoo three stages are clearly distinguished: (1) period of infancy, when their black skin is sprinkled with snow-white "hairs" or rudimentary down; (2) complete quill stage on the sixth day and (3) the climbing stage when on the seventh day the nest is summarily deserted by each bird in order of development, and marked by a sudden though incomplete transition to the feather state.

The cuckoo is remarkably enduring from birth, and its grasping reflex most striking. When born it can support its own weight with one foot or with a single toe. Later with feet and bill it easily raises itself upon any support. At the close of the quill-stage fear is present, and there is perfect association with the nest and parent. The feather tubes now begin to give way at their base, especially over the breast and abdomen, and in the energetic practise of the preening instinct the tubes are combed off by the mouthful and in a few hours. The tubes of the flight-feathers and those of the back break away centripetally, so as to expose the shafts gradually as in other birds. When the bird climbs out of the nest early on the seventh day it is only half fledged, quills still showing on head, neck and back. In the climbing stage, when they remain in bushes for upwards of ten days, their behavior suggests that of the young hoatzin.

In serving the large caterpillars and larvæ which are brought to the nest by both parents, the insect is placed in the *mouth*, and not in the throat, as in nearly all birds observed, and is held there for, it may be, five minutes, neither bird moving, or until the swallowing reflex is started. The last bird in the nest is apt to be deserted, parental instinct being diverted and satisfied by the attentions which those already in the bush demand.

Phototaxis in Fiddler Crabs: S. J. HOLMES, University of Wisconsin.

The Reactions of Amphibians to Light: A. S. PEARSE, University of Michigan.

Ten representative species of amphibians were tested and all of them showed marked phototropic reactions. In most instances these species gave the usual responses after the eyes had been removed, the skin serving as a photoreceptor. When a toad was stimulated through only one eye by light from in front or when the skin of an eyeless toad was subjected to unilateral stimulation by light from above, the resulting locomotion was toward the stimulated side and not toward the source of illumination. Such responses are, therefore, brought about by bilateral differences in stimulation and not by any orienting influence due to the direction of the light rays. Previous conditions of light stimulation had no apparent effect on the photic responses of the toad.

Although the rays toward the violet end of the

spectrum produced the largest number of positive responses from normal salientians, no such potency was manifested by the shorter rays when eyeless individuals were tested. In the latter case all rays were equally effective in inducing reactions.

Eyeless toads which gave marked phototropic responses were indifferent to radiant heat of an energy value equivalent to that of the light used. It may, therefore, be affirmed that thermo- and photo-reception are distinct processes in the toad's skin.

Spinal amphibians gave no photic responses, but light reactions were induced in animals which had lost the portions of the brain anterior to the metencephalon.

The Receptiveness of the Vertebrate Skin for Light and the Origin of the Vertebrate Eye: G. H. Parker, Harvard University.

In the last few years it has been shown that numerous amphibians will respond to light by moving either toward it or away from it even after their eyes have been removed. The receptive organ in this response is the skin. Tests of a like kind have been made on only a very few fishes. It is highly probable that the skin of *Amphioxus* and of *Fundulus* is not sensitive to light and it is very certain that that of ammocœtes is highly sensitive to this stimulus. To ascertain the condition in other fishes, blind individuals of nine species of marine forms were tested by throwing upon the side of the body a beam of concentrated sunlight. The species tested were *Mustelus canis, Anguilla chrysypa, Fundulus heteroclitus, Stenotomus chrysops, Tautogolabrus adspersus, Tautoga onitis, Chilomycterus schœpfi, Opsanus tau* and *Microgadus tomcod.* In no instance was any reaction observed. As all these species and *Amphioxus* are marine and the amphibians and ammocœtes are inhabitants of fresh water, it seems as though fresh water was favorable for the development of integumentary sensitiveness to light and salt water inimical to this. The condition may be just the reverse of animal phosphorescence which is common in the sea, but unknown in fresh water. If further investigation should prove that no marine vertebrate has an integument sensitive to light, such theories of the origin of the vertebrate eyes as derive it from the skin would be rendered highly improbable.

Methods of Studying Color Vision in Animals: Robert M. Yerkes, Harvard University.

There are three general methods of obtaining chromatic stimuli: the reflection method (absorption and reflection by colored papers, cloths, pigments), the transmission method (absorption and transmission by colored glasses, gelatines, solutions) and the refraction method (dispersion spectra by means of prism).

Of these three methods, the first is purely qualitative, and has as its chief recommendation the naturalness of its stimuli. The second method is both qualitative and quantitative, but it fails to give the experimenter that degree of control of the wave-length of his stimulus which is demanded by the thoroughgoing and rigidly scientific quantitative investigation. The third method promises to meet the chief requirements of quantitative work.

These requirements are that the method shall enable the experimenter (1) to obtain stimuli of any desired wave-length or range of wave-lengths, (2) to measure the wave-length of the stimuli accurately and with reasonable facility (preferably by means of a calibrated slit mechanism), (3) to control the intensity of the stimuli perfectly by (*a*) moving the source of light, or (*b*) changing the size of the beam, or (*c*) interrupting the beam, or by each of these methods in turn, (4) to measure the intensity of stimuli accurately and easily both photometrically and radiometrically (preferably by means of a calibrated mechanism), (5) to present chromatic stimuli to his subject independent of the secondary criteria of discrimination: size, form, distance, position, texture of surface and temperature.

Investigations now in progress in the psychological laboratories of Harvard and Johns Hopkins universities, under the direction of the committee on standardization of tests appointed by the American Psychological Association, promise to provide us soon with an admirable method for the study of color vision in animals. A report of the results of these investigations is now in course of preparation by R. M. Yerkes, J. B. Watson and E. D. Congdon.

An Account of Experiments for Determining the Complete Life History of Gasterostomum gracilescens: D. H. Tennent, Bryn Mawr College.

In previous work[1] the writer demonstrated the life history of *Gasterostomum gracilescens* with the exception of infection of the oyster.

During the summer of 1908 I obtained *Lepisosteus osseus* from the region of oyster beds in Newport River, North Carolina, and found that they contained *Gasterostomum* in abundance. The fæces of the fish were found to contain *Gasterostomum* embryos.

[1] *Quart. Jour. Mic. Sci.*, Vol. 49, pp. 635–690.

A mixture of fæces in water was injected between the valves of uninfected oysters and these oysters were placed in a wire box in the water. After one month these were taken up and examined. Of twenty-six oysters thus treated twenty-two were alive and contained sporocysts of *Gasterostomum* immediately outside of the stomach wall.

This experiment completes the demonstration of the life history as follows:

1. Adult *Gasterostomum* in *Lepisosteus osseus* and in *Belone vulgaris*.

2. Sporocysts and cercariæ (*Bucephalus*) in the oyster.

3. Free immature and encysted *Gasterostomum* in *Menidia* and other small fishes which serve as food for *Lepisosteus* and *Belone*.

The work also indicates the probable identity of *Bucephalus polymorphus*, found in fresh-water mussels, and *Bucephalus haimeanus*, found in various marine lamellibranchs.

Embryonic Variability in Echinoids: D. H. TENNENT, Bryn Mawr College.

Study of variations of plutei of same age, but from eggs of different females.

Comparison of fed with unfed plutei.

Study of plutei obtained from eggs of one female which were divided into several portions and each portion fertilized with sperm from a different male.

Variation in the Tentacles of Hydra viridis: ALBERT M. REESE, West Virginia University.

These investigations sought to show (1) the variation in the number of tentacles, (2) the relation between the original number of tentacles and the number regenerated after decapitation and (3) the relation between the number of tentacles of a bud and the number possessed by the parent.

Parke states that the number of tentacles varies from four to eleven; and Rand says that in one hundred and fifty *Hydras* only three had nine tentacles, while about 12 per cent. had eight tentacles.

In the six hundred *Hydras* here studied the tentacles varied in number from four to twelve. Only four individuals with the greater number of tentacles were found. About 54 per cent. of the *Hydras* had eight tentacles, 24 per cent. had seven tentacles, and 15 per cent. had nine tentacles. The other numbers between four and twelve were represented by small percentages.

Even in different parts of the same twenty-foot aquarium the average number of tentacles varied, although the conditions were, apparently, exactly the same.

As has been noted before, the number of tentacles generally increases with the size and the age of the *Hydra*, though, under unfavorable conditions, the number may decrease with age.

As has been stated by former workers, the number of tentacles regenerated by a decapitated individual is nearly always less than the original number possessed by the *Hydra*. The average number of regenerated tentacles for seven-tentacled *Hydras* was 5.73, for eight-tentacled *Hydras* it was 6.47.

Parke states that the number of tentacles on buds varies from four to six, and is always less than the number possessed by the parent. In the *Hydras* here studied the buds had from six to nine tentacles, and in only 50 per cent. of these cases were there less tentacles upon the bud than upon the parent. In 37.5 per cent. of the budding *Hydras* examined the number of tentacles of bud and parent was the same, and in the remaining 12.5 per cent. of cases the bud had actually more tentacles than the parent.

A Report on the First Forty-three Generations of an Experiment concerning the Effects of Disuse: F. E. LUTZ.

The fly, *Drosophila ampelophila*, was bred for more than forty-three generations under conditions which prevented the use of the wings. There was no indication of any degeneration either in the absolute or relative size of the wing or in the venation.

Darwin's Case of Reversion in Poultry: C. B. DAVENPORT, Cold Spring Harbor, N. Y.

The cross between a black Spanish cock and white Silkie hen (an albino) produces black chicks, of which the cocks gain some red in the plumage of those feathers that are red in the jungle fowl. Darwin called this reversion. The second hybrid generation reveals the full story. Typically game-colored males and females appear in this generation. The whole matter is explained on the theory that the Spanish contains the factors: color factor, C; jungle fowl color pattern, J; and extra black coat, N; whereas C and N are absent in the Silkie. In the second hybrid generation theory calls for nine blacks to four whites and three games and this proportion is actually obtained.

A Substitute for the Theory of Warning Coloration: JACOB REIGHARD, University of Michigan.

Many of the coral-reef fishes of the Tortugas region are very conspicuous in their natural en-

vironment, as shown by photographs taken by a submerged camera.

The conspicuousness is of the sort typical of warningly colored insects and is often associated with formidable means of defense.

The conspicuousness is not due to secondary sexual coloration.

These fishes do not show aggressive resemblance and such resemblance is unnecessary for them, since their food consists chiefly of fixed invertebrates.

They do not show protective resemblance and have no need of it, since the coral-reef habitat affords them ample protection from their enemies.

Their conspicuousness is not an instance of warning coloration, since they are readily eaten by the commonest piscivorous fish of the region (*Lutianus griseus*), when removed from the reefs, although this fish possesses color vision, forms associations readily and retains these associations for a considerable time, and has therefore the qualities which would enable it to take advantage of warning coloration in its food.

The conspicuousness of the coral-reef fishes has therefore not arisen through selection of any sort, but is an expression of the action of internal forces (race tendency), in the absence of counteracting selection.

The disagreeable qualities of warningly colored insects is universally held to have been present before these insects became conspicuous. They therefore served at the start to inhibit the attacks of vertebrate foes and thus rendered protective coloration unnecessary for such insects.

The nature of their food has rendered aggressive coloration unnecessary to warningly colored insects.

The conspicuous colors of warningly colored insects have therefore arisen in the absence of selection, under immunity from selection. They are to be attributed to the action of internal forces unchecked by selection.

Other conditions than inedibility may so limit the attacks of vertebrate foes on insects (and other animals) as to render them free from selection from this source and wherever, in such cases, the nature of the food renders aggressive coloration unnecessary the insects are immune from the action of selection and free to develop conspicuousness. Inaccessibility may thus condition conspicuousness, and probably does so in the case of many edible butterflies.

The theory of immunity coloration is proposed as a substitute for the theory of warning coloration, while at the same time it covers certain cases not covered by the theory of warning coloration. Immunity coloration is defined as follows: "Coloration, not sexually dimorphic, which renders an organism in its natural environment conspicuous to vertebrates; which has no selective value, since it does not aid the organism in escaping vertebrate enemies by concealment (protective coloration), nor in approaching its accustomed invertebrate prey (aggressive coloration), and when associated with disagreeable qualities is unnecessary as a warning to vertebrate foes of the existence of such qualities (warning coloration); it is conceived to have arisen through internal forces under immunity of the organism from selection acting on its color characters." The exclusion of sexually dimorphic characters from the definition is provisional.

The Partulæ of the Society Islands, and the Problems of Distribution and Isolation: H. E. Crampton, Columbia University.

The survey of the islands of the Society Group of Polynesia was completed during the years 1907 and 1908, and the results have made it possible to offer relatively final statements regarding the variation and distribution of the species of *Partula* that occur in the group. Each island possesses characteristic forms, that with two exceptions are absent from other islands. The two peaks of Tahiti contain nearly similar forms; the two separated halves of Huaheine have the same species, although these exhibit more differences than the species of Greater and Lesser Tahiti; Tahaa and Raiatea are wider apart, although they have the same encircling reef, and their species are far more differentiated; finally, Borabora and Moorea possess unique forms, in correspondence with their total isolation from other islands.

A comparison of the valley faunas in any and all islands reveals a similar relation between geographical separation and racial divergence, and all the islands agree in demonstrating this correspondence. Evidence was presented showing that environmental influences can not be regarded as the immediate factors for racial differentiation, and that mutation has played a large if not an exclusive part in the process. The rôle of natural selection is restricted to a purely negative part.

The Experimental Modification and Control of the Behavior of Characters in Crossing: W. L. Tower, University of Chicago.

A Theory of the Modification and Origin of Characters in Animals: W. L. Tower, University of Chicago.

Color Inheritance in Crosses Between the Black Rat (Mus rattus) and the Roof Rat (Mus alexandrinus): T. H. MORGAN, Columbia University. (See *American Naturalist*, 1909.)

Some Methods and Results of Pigeon Breeding at the Rhode Island Experiment Station: L. J. COLE, Yale University.

Preliminary Statistics on the Nidification and the Proportions of the Sexes in Pigeons: L. J. COLE, Yale University.

The Inheritance of Egg-producing Ability (Fecundity) in the Domestic Fowl: RAYMOND PEARL and FRANK M. SURFACE, Maine Agricultural Experiment Station.

The data discussed in this paper were obtained from two lines of work. The first of these was an experiment in which for a period of nine years hens have been selected for high egg production. No hens were used as breeders whose production in the pullet year had not been 150 or more eggs. The cockerels used were, after the first year of the experiment, invariably the sons of mothers producing 200 or more eggs in their pullet year.

The second source of data was an experiment in which the inheritance of egg production from mother to daughter was directly measured. Records of the pullet year egg production of 250 daughters of hens laying 200 or more eggs in *their* (the mothers') pullet year were obtained.

Certain of the most important results obtained may be summarily stated as follows:

1. Selection for high egg production carried on for nine consecutive years did not lead to any increase in the average production of the flocks.

2. There was no decrease in variability in egg production as a result of this selection.

3. The present data give no evidence that there is a sensible correlation between mother and daughter in respect to egg production, or that egg-producing ability (fecundity) is sensibly inherited.

4. In this experiment the daughters of "200-egg" hens did not exhibit, when kept under the same environmental conditions, such a high average egg production as did pullets of the same age which were the daughters of birds whose production was less than 200 eggs per year.

5. The daughters of "200-egg" hens were not less variable in respect to egg production than were similar birds whose mothers were not so closely selected.

Color Changes of Ocypoda arenaria: R. P. COWLES, Johns Hopkins University.

Under certain conditions a dark color pattern can be distinctly seen through the carapace of *Ocypoda arenaria;* under other conditions this pattern disappears.

Many experiments were performed to test the effect of intensity of light, degree of temperature, mechanical and chemical stimuli. It was found that the first two factors determined the appearance and the disappearance of the color pattern.

In direct and diffuse sunlight when the temperature is kept low the pattern is visible, but when the temperature is high the pattern disappears.

In the absence of light at low medium and high temperature the pattern fails to appear.

Of the two factors, intensity of light and degree of temperature, the former is the more important.

A Gynandromorphous Crayfish: E. A. ANDREWS, Johns Hopkins University.

A specimen of *Cambarus affinis* proves upon study to be an immature male with a few external sex organs that should appear only upon the female.

This gynandromorph, or individual with a mixture of organs normally found upon two individuals, male and female, has a normal testis with no sign of ovogenesis, and two normal, but little developed deferent ducts and the two normal male papillæ at the bases of the fifth thoracic legs. Moreover, the limbs of the first and the second abdominal somites are as in a normal young male and the hooks of the third thoracic legs are normal.

On the other hand, the third thoracic legs bear two elliptical openings that closely imitate the openings of oviducts. These openings are mere blind cuticular structures and do not communicate with any internal organs.

Most of the gynandromorph crayfishes hitherto known have been females with some male traits.

This case emphasizes the independence of gonad and external sex organ, and is in opposition to internal secretions as a cause of appearance of external sex organs.

Whether such mixtures of sex organs can be due to abnormal fertilizations, to polyspermy, may be decided by future experiments in cross breeding of crayfish. At present the evidence seems to indicate that these gynandromorphs may arise in the ovarian egg.

Organs of Sperm-transfer in Male Crayfish: E. A. ANDREWS, Johns Hopkins University.

Though the sperms of crayfishes appear to be killed by fresh water yet they are transferred by the male to the outside of the female while under water. A comparative study of the reflexes and instincts involved shows the use of three sets of organs in the male that are necessary for the perpetuation of the species. These are the papillæ of the last thoracic limbs and the specialization of the first and the second limbs of the abdomen. In *Cambarus* there are also one or two pairs of hooks upon the thoracic legs.

The anatomy of these structures shows that in *Cambarus* the first abdominal appendage is much more complex and accurately adjusted than had been thought, so that these crayfish are even more highly evolved than they had been considered to be. On the other hand, the like appendage of the crayfish of Japan is not fundamentally as much like that of *Cambarus* as had been thought, but more primitive. This tends to lessen the difficulties of one problem of geographical distribution of crayfish by lessening the resemblance of eastern Asiatic to eastern American forms.

The evolution of the accurately interadjusted male and female organs of sperm-transfer in crayfishes seems to admit of no present scientific explanation.

Pelagic Nemerteans: W. R. COE, Yale University.

Comparative anatomical studies of numerous species from various parts of the world leave little doubt as to the affinities of these aberrant forms. Recent discoveries of pelagic species show that they are distributed around the whole circumference of the globe, and although they do not appear to be abundant in any locality, the Arctic and Antarctic oceans are the only large bodies of water without known representatives. The structure of the proboscis, the arrangement of the muscular layers of the body, and the disposition of the blood vessels, indicate their origin from more than a single one of the more generalized types of Hoplonemerteans.

The Breeding Habits of the Squid: GILMAN A. DREW, University of Maine.

It has long been known that female squid with nearly mature eggs have packages of sperm attached to their outer buccal membrane. This summer Professor E. G. Conklin observed a few packages of sperm on the oviduct of a squid. Observations following this have shown that this is not an uncommon, but, on the other hand, not a universal condition.

The transfer of the sperm to both of these locations has been observed many times during the past summer.

When the sperm is deposited on the oviduct, the male grasps the female around the body just behind the mantle opening, or frequently attaches further back and crawls forward. The dorsal side of the male is usually just below or a little to the left of the ventral side of the female. The male then extends its penis well into its funnel, ejects a bunch of spermatophores, which it catches at the outer opening of the funnel with the end of its left ventral arm. This arm, with the spermatophores, is immediately inserted far into the mantle chamber of the female by the left side of her neck above the funnel, and held there perhaps ten seconds. Its position can sometimes be seen through the transparent mantle of the female. It is then withdrawn, the male releases the female, and a few seconds later the empty cases of the spermatophores escape from the female with the water leaving her funnel. Examination of such a female reveals fresh sperm sacs attached to the oviduct.

The transfer of sperm to the buccal membrane is accomplished while the animals are attached head to head.

The discharge of the spermatophores is similar to *Rossia* as described by Racovitza.

Several females were observed while depositing their eggs. Usually the female rests quietly upon the bottom for several minutes before a string of eggs is to be deposited. In this position she frequently remains until the end of the string protrudes about three quarters of an inch from the funnel. She then begins to swim backward, largely by means of the fin, but partly by water that escapes from the funnel around the egg string. While swimming in this manner, she passes her two dorsal arms between the others and catches the end of the egg string with them and draws it up between the arms as it leaves the funnel. Here it remains for two or three minutes, entirely surrounded by the arms, which are kept nervously moving against each other, while she slowly swims about. Just before sticking the egg string to the bottom, she becomes exceedingly nervous in her actions and frequently goes dancing over the bottom on the tips of her arms with the body perpendicular, in a most sensational manner. Suddenly, while the body is perpendicular, or nearly so, she attaches to the bottom with the ends of her arms, draws down tight against the bottom and then withdraws, leaving the egg string attached.

Molluscan Studies on Lake Champlain: H. F. PERKINS, University of Vermont.

Some Holothurian Structures: CHARLES LINCOLN EDWARDS, Trinity College.

In *Cucumaria frondosa* I have found vestigial anal teeth, well marked in specimens 1–2 mm. long, one developing at the posterior termination of each mid radial line just beyond the bases of the last pair of pedicels and *outside* of the anus. These anal teeth remain small and can be found in a majority of the adult specimens, but are never functional and hence may be regarded as vestigial. In very young *Holothuria floridana* I have found three fan-shaped calcareous plates, two lateral and one posterior, which function somewhat as anal teeth, disappearing in the adult, and they also are vestigial structures.

In *Cucumaria frondosa*, the female has a simple, conical genital papilla, while in the male it is subdivided into three to ten parts. The distal portion of each part bifurcates, a genital pore terminating each branch, while the proximal portions of all parts fuse in the common base. Heretofore subdivided, or multiple, genital papillæ have been known only in a few Elasipoda, but I have seen no record of differentiation in the form of male and female genital papillæ. In one *Thyone* and two *Cucumaria* a genital papilla in the male only has been reported.

The Growth of Parts in the Dogfish: WM. E. KELLICOTT, Woman's College of Baltimore.

The weights of the brain, heart, rectal gland, pancreas, spleen, liver and gonads were determined in a series of 315 dogfish (*Mustelus canis*), including specimens from birth, weighing about 76 grams, up to a maximum observed weight of 8,434 grams.

It was found that these organs did not grow at the same rates nor at the rate of the organism as a whole. These parts, except the gonads, are heaviest, relative to the total weight, at birth or soon thereafter and from this time onward constantly diminish in relative weight.

Since the parts of the organism do not grow similarly, description of its growth by recording total weights does not describe the actual growth processes of the whole organism, but chiefly of some predominating parts—in most vertebrates these are the muscles and connective tissues which make up roughly 75 per cent. of the total weight.

In this indeterminately growing form all the parts mentioned tend to be outgrown by the muscles and supporting tissues; a condition of determinate growth might be derived from this by the action of some mechanism for stopping the growth of these tissues at such a point that the brain and viscera remain competent as physiological elements.

The Criteria of Homology in the Peripheral Nervous System: C. JUDSON HERRICK, University of Chicago.

The synonymy of the peripheral nerves of lower vertebrates is in great confusion. This is largely due to the fact that the exact composition of the various rami (particularly of the cerebral nerves) was formerly imperfectly known, and hence nerves of very diverse composition were often compared on the strength merely of topographic similarities of distribution. With the extension of our knowledge of the nerve components of representative vertebrates, it becomes desirable that a standard method of procedure be established in the determination of homologies and in the selection of names for mixed rami and in other cases in which diversity of usage has arisen. A few rules governing homologies are suggested in the present paper, which will be published in the *Journal of Comparative Neurology and Psychology.*

On a New Species of Goblin Shark (Scapanorhynchus jordani) from Japan: L. HUSSAKOF, American Museum of Natural History.

Scapanorhynchus (*Mitsukurina*) is a rare shark occasionally taken in the deeper waters of Japan. Only one species has hitherto been known, *S. owstoni* Jordan. In the present paper a second species was described, for which the name *S. jordani* was proposed. It differs from *owstoni* in the much lesser protrusibility of the jaw, much smaller spiracle, smaller gill area and the more forward position of the nostril, eye and spiracle.

The proper generic name of this shark was discussed. The fish was originally described by Jordan under the name *Mitsukurina;* but this genus, as has been pointed out by several investigators, is apparently identical with the Cretaceous form *Scapanorhynchus.* The latter name has priority.

Some Features of the Development of Desmognathus fusca: W. A. HILTON, Cornell University.

Tactile Reactions and Polarity in Tentacles of Actinians: H. W. RAND, Harvard University.

The following demonstrations were exhibited:

Specimens of the Partulæ of the Society Islands, Illustrating Distribution and Isolation: H. E. CRAMPTON.

Races of Paramecium and their Relation to Selection and Conjugation: H. S. JENNINGS.

Demonstrations to Illustrate the Modification and Control of Behavior of Characters in Crossing: W. L. TOWER.

Photographs Illustrating the Regenerative Power of the Somatic Cells of Sponges after Removal from the Parent: H. V. WILSON.

Specimens of the 900th Generation of Paramecium, Attained without Artificial Stimulation or Conjugation: L. L. WOODRUFF.

LORANDE LOSS WOODRUFF,
Secretary

YALE UNIVERSITY

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 453d meeting was held January 23, 1909, with President Palmer in the chair. Several informal notes were presented. Mr. F. E. Matthes offered some notes on snow and winter insects collected in the vicinity of Washington. Among the true snow insects especial interest attaches to *Boreus nivalis* (Neuroptera). This insect is common in the northern states, but has hitherto been considered rare in the District of Columbia. On Christmas day, 1908, and at various times in January, 1909, it was found in abundance in Rock Creek Park. On the date first mentioned, two of this species were observed mating on the snow. On the same day large numbers of winter insects belonging to the Hymenoptera were gathered in the same locality. They represent the winter generation of two Cynipid gall flies, consisting of hermaphroditic individuals, whose larval stages are passed in the roots of oak trees. They oviposit in the young buds of the same tree, thus producing the galls on the leaves in which the summer generation develops. It appears essential, according to observations by Dr. E. A. Schwarz and others, that the ovipositing be done as soon as the buds show the first signs of life in spring. It takes place therefore about the end of February as a rule. In view of this, it seems surprising that the insects should have been found at so early a date as December 25, almost two months prior to the first budding of the leaves.

The difficulties attached to any studies whereby the winter generations of these species might be connected with the corresponding summer generations have thus far proved almost insuperable, and as a consequence no definite correlation exists as yet. For the present the individuals of the winter generation (which look quite unlike the summer generation) are referred to the genus *Andricus*. Both *Andricus* species found have atrophied wings, those of the larger species being apparently perfect but about half the size necessary for flight. They thus possess a characteristic also found in *Boreus*. In the male of the latter, however, the wing remnants are of an imperfect and strangely aberrant type.

Mr. M. B. Waite exhibited a Jonathan apple having a peculiar decay. The specimen represented a lot which had been shipped from Colorado to Los Angeles, California, kept there in cold-storage, and then sent to Washington for diagnosis. Three species of apple rot fungi found in the decayed spots were considered secondary since most of the decayed areas were free from fungi or bacteria. The discolored areas, often in the form of a band around the apple, were firm in texture, light brown in color, and extended to a moderate depth in the flesh of the apple. The cells in the discolored areas were collapsed and ruptured, thus coinciding with frost injury. The damaged area was concluded to be due to freezing, or, since the apple stands freezing, to the peculiar conditions of thawing out after freezing.

Dr. H. M. Smith announced and commented upon the transfer of the administration and personnel of the federal fur-seal service to the Bureau of Fisheries.

Dr. B. W. Evermann reported an observation made by his brother, A. M. Evermann, near Burlington, Indiana, showing that fox squirrels sometimes feed upon the seeds of the cocklebur (*Xanthium strumarium*). The observation was made January 19 when snow covered the ground. The squirrels carried the burr to a log at the edge of a field and there got at the kernels by gnawing away one side.

He also reported the capture of a barn owl in Carroll County, Indiana, in December, 1908. This species had not been previously recorded from that county.

The regular program consisted of the following four papers:

Bee Diseases: E. F. PHILLIPS.

The honey bee, *Apis mellifera*, is subject to several specific diseases which are well recognized among practical bee keepers. The causes of all of them are not fully understood. Two of these attack the bee in its embryonic stages and are now designated American foul brood and European foul brood. They attack the bee just about the time that pupation begins and the colony is depleted because as the adult bees die from natural causes there are not enough bees emerging

to replace them. The cause of American foul brood has by inoculation experiments been determined to be *Bacillus larvæ*. This organism grows well only on a medium prepared by mashing healthy bee larvæ and sterilizing by filtration. Fifteen minutes of boiling is required to kill the spores of the bacillus. The cause of European foul brood is not known. There are other maladies of the brood and of the adult bee. The methods of treatment and means of spread were discussed.

Federal Control of Fisheries in International Waters: B. W. EVERMANN.

He discussed briefly the questions of federal control of migratory birds, of migrating fishes, of inter-state waters and of international waters. Attention was called to the valuable work which the Hon. George Shiras, III., has done, and is still doing, in calling attention to the power of the government in matters such as these which experience has demonstrated can not be properly handled by the respective states. When a member of Congress Mr. Shiras introduced two or three bills providing for federal control of migratory birds and fishes, and one providing for federal control of inter-state waters.

On April 11, 1908, a convention was entered into between the United States and Great Britain according to the terms of which uniform regulations will be provided governing the fisheries on the United States and Canadian sides of our northern boundary. The special International Fisheries Commission appointed under the treaty is now drawing up its report which must be submitted to the respective governments by June 3. This report, it is understood, will contain a complete system of regulations for the fisheries in all international waters between the United States and Canada.

A Remarkable Flight of Bats in Luzon: HUGH M. SMITH.

He presented notes on a remarkable flight of small bats observed by him near Montalban, Luzon, P. I., on December 31, 1907. At 5.40 P.M. a solid column of bats began to emerge from a large cave about 1,200 feet above the Mariquina River. The bats flew rapidly in a straight, unbroken, closely-packed line for fifteen minutes, and disappeared over a mountain range in the direction of Manila without a single bat having left the column. American engineers at the place reported that this flight had occurred at practically the same time each day during the two years they had been there; and from other sources it was learned that the same thing had been observed for at least thirty years.

A Visit to the Bat Cave in Luzon: PAUL BARTSCH.

He described the cave from which came the flight of bats referred to by the preceding speaker. The cave is a large one. Its main entrance is about 35 feet high and 25 feet wide, and difficult of access. A short passage connects the entrance with the central dome which has a diameter of about 150 feet and height of about 200 feet and perforates the mountain top. From this chamber passages open in various directions, frequently expanding into large rooms, some of which have wonderful stalagmites and stalactites, while others are simply glazed with a glistening lime deposit. An hour and a half was spent going from chamber to chamber and the native guide stated that he might continue for half a day without retracing his steps. Bats of several species were seen flitting about or clinging to the wall of the cave everywhere, but not enough to make a hundredth part of the swarm seen on the night of the last of December, 1907. Owing to the failure of the bat flight the previous night (July 4, 1908) the party had expected to find dead bats in the cave, believing that some epidemic might have killed them. This seemed the probable solution since on their previous visit the party had been assured that the bats had never been known to fail to make their appearance at a certain hour for many years. Careful search of the floor which was richly covered with guano, failed to reveal any dead individuals, and the whereabouts of the immense flight remains a mystery at present.

M. C. MARSH,
Recording Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

THE 188th meeting of the Washington Chemical Society was held at the Cosmos Club on Thursday, February 11, 1909, at 8 P.M. President Walker presided, the attendance being 62. Eleven new members were added to the roll and two resignations were announced. J. M. Bell, of the Bureau of Soils, was appointed chairman of the committee on communications and M. X. Sullivan, of the Bureau of Soils, chairman of the entertainment committee. Arrangements were announced to hold the annual smoker at the Riggs House on Thursday, February 18. The following papers were presented:

"The Formation of Gluconic Acid by the Olive Tubercle Organism and its Physiological Function," by C. L. Alsberg.

"The Chemical Constituents of Oil of Erigeron and Wild Sage," by Frank Rabak.

"China Wood Oil," by E. W. Boughton.

J. A. LE CLERC,
Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

AT the 428th regular meeting of the Society, held at the Cosmos Club February 2, 1909, the following program was presented:

A Newly Discovered Siouan Dialect: DR. JOHN R. SWANTON.

Dr. Swanton visited the small remnant of Tunica Indians living close to Marksville, La., in November, 1908, for the purpose of correcting and amplifying the linguistic material recorded by Dr. Gatschet over twenty years ago. In the course of his investigations he had the good fortune to find a single survivor of an Indian tribe formerly living on the Yazoo River and known from French accounts as Offogoula. A sufficient vocabulary was obtained to show that the language spoken by them was not Muskhogean, as had hitherto been supposed, but a Siouan dialect related to those of the Biloxi and the eastern Siouan tribes. It is peculiar in substituting f for s in many situations and tc for y in others. The proper name of the tribe is Ofo, and probably has nothing to do with Choctaw ofe, "dog," as has hitherto been supposed.

Exhibition of Ethnographic Specimens by Members of the Society.

Dr. I. M. Casanowicz exhibited a silver lamp with eight burners used by the Jews in the Hanuga ceremony, the origin of which was explained at some length. This lamp is the property of Ephraim Benguiat, of New York. Dr. Casanowicz also showed a design representing a globe made of the book of Ecclesiastes in Hebrew characters in a single line.

Mr. Edwin P. Upham, of the Smithsonian Institution, exhibited and gave the place of origin of a series of stone scrapers and a series of stone axes. A general examination and discussion followed on the part of the members of the society.

JOHN R. SWANTON,
Secretary

THE BIOLOGICAL AND GEOLOGICAL SECTION OF THE ACADEMY OF SCIENCE AND ART OF PITTSBURG

AT a regular meeting of the section on February 2, Mr. F. G. Clapp spoke on the "Influence of Geological Structure on the Occurrence of Oil and Gas." Mr. Clapp briefly discussed the "anticlinal theory" of White and Orton and indicated the other factors which must always be considered in connection with it in order to make determinations of practical value. The following generalizations were made in regard to the fields of southwestern Pennsylvania and northern West Virginia:

1. All conditions being favorable, the accumulations of oil and gas do show a definite relation to the geologic structure.

2. With but few exceptions the greatest elongation of the pools is approximately parallel to the axes of the folds.

3. When both oil and gas are present in a stratum of sandstone, they are distributed according to their densities, the oil in the lower and the gas in the higher portion of the layer.

4. When oil and salt water are present the oil generally occurs in the part of the stratum lying directly above the water level.

5. When salt water is absent the oil may occur at the bottom of the syncline, or may be part way up the anticlinal slope.

6. Oil may occur on a "structural bench," where the dip of a stratum changes from gentle to steep.

7. Gas occurs mainly near the crests of anticlinal folds.

8. It occurs, however, in greatest volume in certain portions of the anticlinal crests which take the form of structural "domes."

9. Gas occurs in volume also at many widely scattered points, due to local changes in the dip and texture of the rocks.

The unconformity at the base of the Pottsville formation was briefly described, and the statement made that in certain fields it has a decided influence on the relation existing between the position of the oil and gas deposits and the geological structure as determined by the surface rocks. In general the interval between the surface rocks and the deeper oil and gas "sands" diminishes toward the north and west, and this change frequently shifts the axes of the anticlines and synclines in the deeper sands a fraction of a mile from the position of the same axes in the surface formations. Other changes in the intervals between the various sands must be taken into account in locating oil or gas deposits.

PERCY E. RAYMOND,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 19, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE FIRST PAN-AMERICAN SCIENTIFIC CONGRESS, HELD IN SANTIAGO, CHILE, DECEMBER 25, 1908–JANUARY 6, 1909

THE first Latin-American Scientific Congress, which was convened in Buenos Aires in 1898, was projected by the Scientific Society of that city, and successfully carried out. It was attended by representatives of twelve Latin-American republics, and yielded results of such importance that a second congress was convened at Montevideo in 1901; and this was followed by a third at Rio Janeiro in 1905. Arrangements were made for a fourth meeting at Santiago, Chile, in 1908, and the Chilean organization committee,[1] feeling that the activities of the congress, which had been limited to the discussion of Latin-American problems and interests chiefly, should be extended to a fully Pan-American scope, decided that the Santiago meeting should be known as "The First Pan-American Scientific Congress."

The organization committee, through the medium of the Chilean government, extended to the government of the United States an invitation to participate. Secretary Root brought the matter to the attention of President Roosevelt,[2] and the

[1] The organization committee was constituted as follows: *Honorary President*, Marcial Martinez; *President*, Valentin Letelier; *Vice-president*, Manuel E. Ballesteros; *General Secretary*, Eduardo Poirier; *Assistant Secretary*, Augusto Vicuna S.; *Treasurer*, Octavio Maira; Alejandro Alvarez, Jose Ramon Gutietrez, Salvador Izquierdo S., Alejandro del Rio, Miguel Varas, Luis Espejo Varas, Anselmo Hevia Riquelme, Vicente Izquierdo, Domingo V. Santa Maria.

[2] *The President:* The government of Chile has invited the government of the United States to

President transmitted the invitation to Congress, accompanied by a commendatory message.[8] In due course the invitation was officially accepted, and a liberal sum appropriated for the purposes of the congress. The committee of organization also extended invitations, through the Department of State at Washington, to a number of universities and other institutions and societies. As a result a large delegation was accredited to the congress. The membership of the delegation and the institutions represented are as follows:

Government Delegates

L. S. Rowe, University of Pennsylvania.
Paul S. Reinsch, University of Wisconsin.
Hiram Bingham, Yale University.
A. C. Coolidge, Harvard University.

join in and to be represented by delegates at the Pan-American Scientific Congress, which is to assemble under its auspices at the capital city of Santiago during the ten days beginning December 25, 1908. The work of the congress will comprehend nine sections, devoted, respectively, to pure and applied mathematics, physical sciences, natural sciences, engineering, medicine and hygiene, anthropology, jurisprudence and sociology, pedagogics, and agriculture and animal industry.

Latin-American scientific congresses were held in 1898 at Buenos Aires, in 1901 at Montevideo and in 1905 at Rio de Janeiro. Growing out of these previous conferences the congress of 1908 will be for the first time Pan-American. It will study and discuss many great subjects in which all the American republics have in common special interests; and its aim is to bring together the best scientific thought of this hemisphere for the scrutiny of many distinctively American problems and for an interchange of experience and of views which should be of great value to all the nations concerned.

It is therefore eminently appropriate that the United States should be adequately represented at this important First Pan-American Scientific Congress and should embrace this opportunity for cooperation in scientific research with the representatives of the other American republics. It is worthy of consideration that, in addition to the purely scientific interests to be subserved by such a congress and in addition to the advantages arising from an interchange of thought and the intercourse of the scientific men of the American countries and the good understanding and friendly relations which will be promoted, there are many specific relations arising from the very close intercourse between the United States and many Latin-American countries, incident to our expanding trade, our extending investments, and the construction of the Panama Canal, which make a common understanding and free exchange of opinion upon scientific subjects of great practical importance.

To make our representation possible I have the honor to recommend that the Congress be asked to appropriate the sum of $35,000, or so much thereof as may be necessary, to enable the United States to send a number of delegates corresponding to the number of sections into which the congress is to be divided, together with a secretary and disbursing officer, and to pay other necessary expenses.

Inasmuch as it is desired that all communications or scientific works to be presented to the congress be received before September 30, it is much to be hoped that provision for the participation of this government may be made at an early date and that the appropriation be made immediately available.

Respectfully submitted,

ELIHU ROOT

Department of State,
Washington, December 19, 1907.

To the Senate and House of Representatives:

I transmit herewith for the consideration of the respective Houses of the Congress a report of the Secretary of State representing the appropriateness of early action in order that in response to the invitation of the government of Chile the government of the United States may be enabled fittingly to be represented at the First Pan-American Scientific Congress, to be held at Santiago, Chile, the first ten days of December, 1908.

The recommendations of this report have my hearty approval, and I hope that the Congress will see fit to make timely provision to enable the government to respond appropriately to the invitation of the government of Chile in the sending of delegates to a congress which can not fail to be of great interest and importance to the governments and peoples of all the American republics.

THEODORE ROOSEVELT

The White House,
December 21, 1907

William C. Gorgas, United States Army.
W. H. Holmes, Smithsonian Institution.
Bernard Moses, University of California.
George M. Rommel, Bureau of Animal Industry.
W. R. Shepherd, Columbia University.
W. B. Smith, Tulane University.

University Delegates

Bernard Moses, University of California.
Albert A. Michelson, University of Chicago.
J. Lawrence Laughlin, University of Chicago.
W. R. Shepherd, Columbia University.
Thomas Barbour, Harvard University.
A. C. Coolidge, Harvard University.
J. B. Woodworth, Harvard University.
Adolph Hempel, University of Illinois.
W. H. Holmes, George Washington University.
Orville A. Derby, Cornell University.
H. D. Curtis, University of Michigan.
W. F. Rice, Northwestern University.
L. S. Rowe, University of Pennsylvania.
Webster L. Browning, Princeton University.
William B. Smith, Tulane University.
Paul S. Reinsch, University of Wisconsin.
Hiram Bingham, Yale University.

Scientific Societies

L. S. Rowe, American Academy of Political and Social Science.
L. J. Doran, National Educational Association.

In June, 1908, meetings of the government delegates were held at the State Department, Washington, under the tutelage of Secretary Root, who conveyed to them such instructions as were deemed necessary. Arrangements were made for the preparation and translation of papers dealing with appropriate subjects for presentation at the congress, and for the disposal of the sum allotted by the Department for the purposes of the congress. The organization of the delegation was completed by the selection of Dr. L. S. Rowe as chairman and Professor Paul S. Reinsch as vice-chairman.

Under the guidance of Dr. Rowe a number of the delegates assembled in Buenos Ayres early in December, where they were the recipients of the hospitality of the president of the republic and the members of his cabinet, and of the ministers of the United States and Chile. Visits were made to numerous institutions of learning, hospitals, municipal buildings, parks, etc., and the visit to the University of La Plata was signalized by an exceptionally cordial interchange of courtesies. On December 10 the party crossed the Andes and established headquarters in the Hotel Oddo in Santiago. Here, before and during the sittings of the congress, the delegation held frequent meetings to plan and discuss their work in the congress. Meantime other delegations, representing seven North American and Central American and nine South American republics, were on hand; and the meeting for the selection of officers for the congress was held at the University of Chile on December 24.[4]

At 10 P.M. on Christmas Day the opening session was held in the spacious Municipal Theater, and proved a most impressive ceremony. The president of the republic, Señor Pedro Montt, was present, and addresses were made by various officials of the congress and by chairmen of the various national delegations. The address of Dr. Rowe, chairman of the American delegation, delivered in Spanish, was enthusiastically received.[5]

[4] The result was as follows: *President*, Enrique R. Lisboa, Envoy Extraordinary and Minister Plenipotentiary of Brazil; *Vice-presidents*, Lorenzo Anadon, Envoy Extraordinary and Minister Plenipotentiary of Argentina; Fredrico Susviela Guarch, Delegate of Uruguay, and Matias Manzanilla, Delegate of Peru; *Secretaries*, Emilio Fernandez, Delegate of Bolivia; Melchor Lasso de la Vega, Delegate of Panama, and Enrique Martinez Sobral, Delegate of Mexico.

[5] ADDRESS OF DR. L. S. ROWE AT THE OPENING SESSION

Your Excellency, Ladies and Gentlemen:

This congress possesses an historical significance which it is difficult for us to appreciate at the present time. It marks an epoch in the intellectual development of the American continent.

Complete isolation from one another has characterized the situation of the countries of this

The committee of organization was prompt in the preparation of the program continent. This isolation has been one of the greatest obstacles to progress. The failure to develop a spirit of intellectual cooperation has resulted in a great loss of energy and has been one of the most important obstacles to the solution of many problems which would long ago have been solved had we been able to unite our energies and profit by each other's experience. The true scientific spirit has a far deeper significance than the mere desire to conduct investigations. It can not reach its highest expression if there exist petty rivalries or jealousies. For this reason the development of the scientific spirit contributes so much to the growth of a true international fraternal spirit. A vigorous spirit of cooperation, developed amongst the scientists of the American continent, will enable us to destroy the last traces of the epoch in which the words "stranger" and "enemy" were synonymous.

The industrial development of the last century offers lessons of much importance to the scientific world. A study of the economic growth of modern countries clearly shows that the principle of competition is gradually giving way to the principle of cooperation.

The formation of trusts as well as the growth of trades' unions constitutes the concrete expression of these new tendencies. The eighteenth century and a considerable portion of the nineteenth were dominated by a spirit of individualism. During more than four generations, it was taken for granted that human progress is dependent on the struggle for existence and the conflict between individual and individual. During the nineteenth century the application of biological principles to human society strengthened this idea. It is the mission of the twentieth century to demonstrate that we must regard the principle of cooperation rather than that of competition as the fundamental principle of social progress.

In this congress it is our high privilege to inaugurate a new epoch giving concrete form to the idea of intellectual cooperation. In the International Bureau of American Republics we have a central organization admirably adapted to contribute toward the realization of this idea. We need such a center in order to place investigators in different portions of the American continent in contact with one another, and in order that the results of such investigations may be made the common property of all the nations of America.

In the name of the delegation of the United States of America, I desire to express our sincere thanks for this opportunity to take part in the deliberations of this congress. No better opportunity could have been offered to become acquainted with our colleagues and fellow investigators. The ties here formed possess a significance far deeper than the personal satisfaction they imply. This visit can not help but enlarge our mental horizon, broaden our scientific activity, and strengthen the influence of our university instruction. We congratulate ourselves on the privilege of being present, and desire also to express our appreciation of the great service performed by this republic in giving such vigorous impulse to the spirit of scientific solidarity.

of meetings, and the press of the city was most generous and helpful in its treatment of the congress. The sectional meetings, which continued during eight days, were held separately under the following heads:

1. Mathematics, Pure and Applied.
2. Physical and Chemical Sciences.
3. Natural Sciences—Biology, Paleontology, Geology, Anthropology, etc.
4. Engineering.
5. Medicine and Hygiene.
6. Jurisprudence.
7. Social Sciences.
8. Pedagogic Sciences.
9. Agriculture and Zootechny.

The program was followed, with necessary modifications from day to day. The majority of the papers were read in full or in extended abstracts, and discussion was free and often spirited. Naturally, popular interest centered largely about the sections dealing with practical problems, as education, sanitation, social science and engineering; but the more abstract sciences were not neglected. Owing to the great range of the work of the congress and the multiplicity of papers presented in the various sections, no attempt can be made in this place to present the work and results in detail. The list of papers presented by members of the American delegation and forwarded by the other

contributors for the United States is as follows:*

Astronomical Problems of the Southern Hemisphere: H. D. CURTIS.

The Electronic Theory of Matter: W. B. SMITH.

Recent Progress in Spectroscopy: A. A. MICHELSON.

Statistics of the Use of Nitrate of Soda in the United States: CHARLES E. MUNROE.

The Economy of Fuels: WILLIAM KENT.

Recent Studies in Experimental Evolution: THOMAS BARBOUR.

Notes on the Origin of the North American Prairies: C. H. HALL.

Origin of the Minnesota Iron Ores: C. H. HALL.

The Peopling of America: W. H. HOLMES.

The Newer Geological Views Regarding Subterranean Waters: JAMES F. KEMP.

The Mineral Wealth of America: R. W. RAYMOND and W. R. INGALLS.

The Shaler Memorial Expedition in Brazil and Chile: J. B. WOODWORTH.

The Application of Electricity to Railways: FRANK SPRAGUE.

Sanitation in the Tropics with Relation to Malaria and Yellow Fever: W. C. GORGAS.

Frequency and Prevention of Yellow Fever: C. J. FINLAY.

Notes on the Sanitation of Yellow Fever and Malaria from Isthmian Experience: H. A. CARTER.

Plague; Methods of Control: J. C. PERRY.

America in the Pacific: A. C. COOLIDGE.

America and International Law: PAUL S. REINSCH.

Public Opinion in the American Democracies: L. S. ROWE.

Why the English Colonies on Achieving their Independence Constituted a Single State, whereas the Latin-American Colonies could not Form a Federation among Themselves, nor even a Confederation: HIRAM BINGHAM.

Geological Work in Brazil: ORVILLE A. DERBY.

Foundations of the Spanish and English Colonial Civilization in America: BERNARD MOSES.

American Banks: J. LAWRENCE LAUGHLIN.

Uniformity and Cooperation in the Census Methods of the Republics of the American Continent: S. N. D. NORTH.

The Influence of Urban Environment on the Life and Thought of the People: L. S. ROWE.

The Treatment of Indian Tribes of the United States: FRANCIS E. LEUPP.

Race Degeneration: W. B. SMITH.

The Reclaiming of Arid Lands in the United States: F. H. NEWELL.

Instruction in Animal Husbandry at Agricultural Colleges of the United States: GEORGE M. ROMMEL.

National Sanitary Police in the United States: GEORGE M. ROMMEL.

The Tendencies of Female Education and its Bearing on the Social Mission of the Women of America: WM. F. RICE.

Laws of Heredity: THOMAS BARBOUR.

Adaptation of Instruction to the American Social Medium: W. R. SHEPHERD.

Nurses as Assistants in the Medical Inspection of Schools: DORA KEEN.

Recent Advances in the Study of Typhoid Fever: M. J. ROSENAU.

Pensioning Mothers who Depend on the Labor of their Sons, to Enable the latter to Pursue their Studies: DORA KEEN.

Plans and Gauges of Intercontinental Railways: WM. J. WILGUS.

Some Phases of the Early History of Mexico and Central America: ALCÉE FORTIER.

The Writing of History in the United States: W. M. SLOANE.

The Value of Gas Power: CHARLES E. LUCKE.

Uniformity of Commercial Law throughout the American Continent: ROSCOE POUND.

Pan-American Terminology: C. O. MAILLOUX.

Car Lighting in North America: R. M. DIXON.

Reinforced Concrete Construction for South America: WM. H. BURR.

The New Philippine Currency System: E. W. KEMMERER.

Water Supply of Cities and Towns: ALLEN HAZEN.

Use of Tertiary Coals in General Metallurgy and in the Manufacture of Coke: WM. HUTTON BLAUVELT.

The Supply of Potable Water: RUDOLPH HERING.

An Analysis of Five Hundred Cases of Epidemic Meningitis Treated with the Antimeningitis Serum: JAMES W. JOBLING and SIMON FLEXNER.

American Agriculture in Its Relation to Chilean Nitrate: WM. S. MYERS.

The Processes for the Concentration of Ore: ROBERT H. RICHARDS.

Future Supply of Iron Ore: HENRY M. HOWE.

The concluding session of the Congress was held at the university in the forenoon of January 5, and various matters of gen-

* This list is in part a translation from the Spanish, and may be somewhat imperfect.

eral interest were disposed of. These included a discussion of methods of procedure, policy and scope of future congresses, relation of the congress to government and science, etc. A number of resolutions, passed by the sections or presented by the delegations, were offered and adopted.[7]

[7] Resolution, extending to the governing board and director of the International Bureau of American Republics the thanks of the Pan-American Scientific Congress for the offer of cooperation:

WHEREAS: The Pan-American Scientific Congress has received with much satisfaction the cordial message of greetings from the Bureau of American Republics, and the kind offer of cooperation, be it

Resolved, That the formal thanks of the congress be transmitted to the governing board and director of the bureau, and that it be recommended to the members of the organization committee of the next Scientific Congress to avail themselves in every possible way of the valuable services which the bureau can render.

Resolution, recommending the establishment of a Section of American Bibliography in the International Bureau of the American Republics.

Recognizing the importance of establishing closer relations between investigators throughout the American continent and of disseminating the results of scientific investigations, the Pan-American Scientific Congress

Resolves, To recommend to the governing board of the International Bureau of the American Republics:

1. That a special section be established in the International Bureau of the American Republics to be known as the "Section of American Bibliography."

2. That the director of the bureau invite authors and investigators to send their publications to the bureau, on receipt of which notice thereof will be published in the Bulletin, which notice shall include a brief summary of the contents of such publication and the price thereof.

3. That the bureau secure for investigators any such publications at a price to be indicated in the Bulletin.

4. That the bureau endeavor so far as practicable to secure official publications for investigators.

5. That the bureau keep a record of the published progress of larger schemes of scientific investigations of Pan-American bearing.

By a practically unanimous vote it was decided to hold the next meeting in Washington in October, 1912. This action was cabled to the State Department, and Secretary Root responded in the following message:

Please express to the Pan-American Scientific Congress the satisfaction with which this government receives the announcement that Washington has been selected as the meeting-place of the congress in 1912.

A committee of five members[8] was appointed to arrange with the Department of State at Washington for the appointment of a permanent organization committee for the prospective meeting.

A farewell session was held in the Municipal Theater on the afternoon of January 5, at which fitting addresses were made by officials and delegates;[9] and at

[8] L. S. Rowe, George H. Rommel, W. H. Holmes, John Barrett, director of the Bureau of American Republics, and Elmer E. Brown, commissioner of education.

[9] CLOSING ADDRESS OF DR. L. S. ROWE

Mr. President, Ladies and Gentlemen:

The honor conferred upon my country through the designation of Washington as the next meeting place of this great assembly is the more significant because of its spontaneous character. For this demonstration of confidence, good will and fraternal solidarity I want to thank you, not only in the name of the delegation of the United States of America, but also on behalf of that larger body of scientists and investigators who are imbued with the same spirit that has actuated this congress, and who now look forward to the privilege of welcoming to our shores the men upon whose efforts the progress of this continent depends. We can not hope to surpass the hospitality of this great republic, but we can assure you that the welcome will be no less sincere, and the determination to place every possible facility at your disposal, no less effective than has been the case here in Chile.

Viewed in its proper perspective, this congress has been one of the most extraordinary assemblages of modern times; more extraordinary in many respects than either the Hague or the Pan-American conferences. That a large group of men,

night a dinner was given in the hall of the university, at which there was a generous expression of good feeling and a striking display of oratory.

The social features of the congress were most noteworthy. The president of the republic, besides giving the usual official reception, entertained the foreign delegates at dinner, invitations being extended to a limited number each day during the congress. Receptions were given under government auspices at the principal social clubs. The American Minister, the French, Brazilian and Argentine Ministers, and numerous prominent citizens entertained the delegates. Members of the American and other delegations were guests at a number of charming haciendas in the vicinity of Santiago; and the American delegation entertained at dinner members of the organization committee, chairmen of various national delegations and others. Visits were made to institutions of learning, museums, art galleries, hospitals and manufacturing establishments, and no effort was spared by the officials of the congress to make the visit of the foreign delegates enjoyable and profitable. The writer wishes to express his personal appreciation of these courte-

representatives of every section of a great continent, should be able to get together and, casting aside all petty prejudices, freely and frankly exchange the results of their careful investigations and ripe experience, is not only a tribute to the culture of this continent, but is also an indication of the extent to which our ideas have advanced beyond those which we inherited from our European mother countries.

The fact that we have met to place the results of the best scientific thought at the disposal of all the countries here represented, and through them at the service of the civilized world, contains a lesson of deep and lasting import which no other assembly of modern times has been able so clearly to impress upon the civilized world.

The historian of the intellectual development of the American continent, in reviewing the work of these assemblies, will probably give to the Santiago congress the honor of having clearly demonstrated that the republics of the American continent, because of their geographical position; because of the peculiar conditions under which they were settled; and because of the special racial problems which they present, are confronted by a series of problems distinctively American. The mere fact of the existence of these problems involves an obligation not only to ourselves, but to the civilized world to concentrate our efforts upon their solution. Through their solution we can make that contribution to the progress of mankind which the world has the right to expect of us.

We can best hope to do this by carrying to our respective countries the spirit that has hovered over this congress—that of service in its broadest and highest sense. This spirit of service must be made the key-note of our national and of our international relations. The republics of the American continent must demonstrate to the civilized world that the willingness and determination to be of service to our fellow-men is the corner-stone of a philosophy which the nations of this continent are determined to make the guiding principle of their conduct.

I can see a time, not far distant, when with each conquest of science the question will immediately arise in the mind of every American, "How can these results be made of service to the democracies of this continent?"—a time when in every field of endeavor the American republics may call upon one another for counsel in the solution of their problems, and be certain to receive the best expert advice. Then, and not till then, shall we have developed a real continental spirit; then, and not till then, shall we have fulfilled the obligations which our privileged position in the world's affairs has placed upon us. I can imagine no greater distinction for the next congress than the possibility of marking a further step in the development of this spirit of service and of continental solidarity.

And now, in closing, let me again extend the thanks of the delegation of the United States of America to you, the members of the organizing committee, for your broad grasp of the purposes of the congress and the skill with which these purposes have been made real and effective; to you, our colleagues, for your cordial reception of newcomers in your midst, and finally to the government and people of Chile for the warm-hearted hospitality which we have enjoyed.

sies and attentions, and to say that he approached South America somewhat oppressed by the thought that he should find himself a stranger in a strange land, but that, on the contrary, there was not a day of the two months spent in the Latin-American countries on which he was not made to feel entirely at home and among appreciative and generous friends.

The universal feeling at the close of the congress was that the meeting had fully justified the plans of its projectors; and the story is not entirely told when it is stated that the elaborate program, covering nearly every branch of science, was successfully carried out. The more thoughtful find in this and in kindred assemblages, much that is of significance for the future of the American republics. This congress was a decided step in the direction of bringing about a better understanding among the nations represented. It was a step toward a fuller appreciation of the common interests of each and every American nation. It was an appreciable forward step in the development of the means and methods of promoting the common interests of the continent. It was a step toward making the experience and the accumulated wisdom of each people represented the experience and wisdom of all. In the Section of Pedagogy, the best that has been developed in the theory and practise of teaching was made the common property of all the American republics. In the Section of Sanitary and Medical Science, the latest achievements of each nation in the battle with disease were made familiar to every participant. In the Section of Agriculture and Zootechny, steps were taken in the direction of properly utilizing and conserving the resources of the continent in these important realms. In the Section of Engineering, the best methods of overcoming the various physical obstacles to progress and of winning the riches of the earth, were explained for the benefit of all America. In the Section of Government and Law, the principles of statecraft and the administration of justice were discussed for the benefit of every American government. In the Section of the Fiscal Sciences, practical methods of conducting the monetary affairs of the nations were presented and explained. And in every other branch of science, practical and abstract, the various forces and agencies that contribute toward progress and enlightenment were in a measure the subject of serious attention. The congress was an initial step toward making the best of all the peoples of the western hemisphere. It was an initial step in making the best, for to-day and for all time, of the resources of the continent. It was an initial step which in many ways must make for the peace and prosperity of the continent. It was a noteworthy step in conformity with manifest destiny as expressed in the phrase "America for Americans."

The success of the congress of 1912 depends upon the interest displayed in it by the scientific world, and on the support accorded by the Pan-American governments. The time is ample, and the appointment of an organization committee representative of a wide range of scientific interests is the first step in making the Washington meeting an event worthy of the nation and its capital.

W. H. HOLMES

BUREAU OF AMERICAN ETHNOLOGY

MARTIN HANS BOYE

DR. M. H. BOYÈ died at Coopersburg, near Bethlehem, Pa., on March 5, aged ninety-seven years. He was born in Copenhagen, Denmark, in 1812, and in 1832 was graduated from the University of Copenhagen and in 1835 from its Polytechnic School, studying under Oersted, Zeise and Fodchhammer. In 1836 he removed to Philadelphia and entered the University of Pennsylvania, studying chemis-

try under the late Dr. Robert Hare. He was graduated from the university as doctor of medicine, but never practised regularly. In 1838 he was appointed assistant geologist of the first geologic survey of Pennsylvania. In 1845 he was elected professor of natural philosophy and chemistry in the Central High School of Philadelphia and retained this position for fourteen years.

In 1839 he was associated with Robert and James Rodgers, in analyzing limestone, coal, iron ore, etc. While engaged in these analyses he discovered a new compound of platinum chloride with nitric oxide. Because of this discovery he was elected to the American Philosophical Society, and in 1840 helped to organize the American Association of Geologists. He was the only surviving founder of this association and of its successor, the American Association for the Advancement of Science, of which he was a fellow for sixty years. In 1848 he also discovered the first of the violent explosives, perchloric ether, which he proved was ten times as powerful as gunpowder. He also found a safeguard against its unexpected explosion by dilution with alcohol. He was thus an important pioneer in the field of smokeless powder.

Dr. Boyè was the author of many papers on scientific subjects. In 1845 he invented a process of refining oil from cotton. Heretofore the product refined was almost black and very thick. His method produced a bland and colorless oil adapted for cooking or for salad dressing. At the age of eighty-one Dr. Boyè made an extended trip to Alaska, and at the age of eighty-five visited Honolulu and witnessed the transfer of the Hawaiian Island to the United States.

In his will Dr. Boyè devised the sum of $12,000 to the University of Pennsylvania Hospital.

THE DARWIN CENTENARY

THE council of the senate of Cambridge University reports that the committee appointed by the council has informed the council that in July of last year letters signed by the chancellor were sent to more than 300 universities, colleges, academies and other corporate bodies inviting them to appoint delegates to attend the Darwin celebration from June 22 to June 24, 1909. In answer to these invitations more than 200 delegates have been appointed. Since the beginning of the year individual letters of invitation have also been sent by the vice-chancellor to certain distinguished men of science, benefactors of the university and others.

A letter containing an invitation to a banquet on June 23 has been sent to about 150 resident members of the university, including heads of colleges, officers, professors and readers, members of council, university lecturers, demonstrators and other teachers connected with biological departments, fellows of Christ's College, contributors to the volume of essays, "Darwin and Modern Science," to be published by the University Press, and a few others selected on account of their official position or because of their connection with biological science. It is proposed to hold the banquet in the new Examination Hall, and it is estimated that between four and five hundred of those who have been invited will be present.

It is proposed that a letter of invitation to the reception by the chancellor in the Fitzwilliam Museum, on June 22, should be sent by the vice-chancellor to every member of the electoral roll.

A copy of the provisional program has been sent to all delegates. The committee has furnished the council with an approximate estimate of the expense likely to be incurred in carrying out the program. This amounts to considerably more than £500, but it is hoped that it may be possible to provide the excess above that sum by private subscriptions, and the council does not therefore ask the senate to authorize the expenditure of more than £500 from the university chest.

SCIENTIFIC NOTES AND NEWS

THE many friends of Major J. W. Powell, both in this country and abroad, will be glad to learn that congress appropriated $5,000 for the erection of a memorial to him, on the brink of the Grand Canyon of the Colorado which he explored.

DR. J. J. STEVENSON, who has recently retired from the active duties of the chair of geology at New York University, has gone to California. He expects to spend the summer in Europe.

MR. C. L. VAN DINE, Stanford, about 1900, late territorial entomologist of Hawaii, has been appointed special agent of the Department of Agriculture in charge of sugar-cane and rice investigations. Mr. David T. Fullaway, Stanford, 1908, his assistant, is promoted to be territorial entomologist of Hawaii.

PROFESSOR WM. W. PAYNE has resigned the directorship of Goodsell Observatory, Carleton College, and has retired upon the Carnegie Foundation. He retains charge of the observatory time service and is still owner, editor and publisher of *Popular Astronomy*. Dr. H. C. Wilson has been appointed director of the observatory.

MR. R. C. PUNNETT has been appointed superintendent of the museum of zoology, at Cambridge, in succession to Dr. S. F. Harmer, who recently accepted the keepership in zoology at the British Museum of Natural History.

M. DELAFOND will succeed M. Nivoit as director of the Paris School of Mines.

THE University of Edinburgh will, at the approaching spring graduation, confer the honorary degree of LL.D. on Professor Alexander Crum Brown, till lately professor of chemistry in that university.

DR. ADOLF FRANK, the eminent chemist, has celebrated his seventy-fifth birthday.

THE portraits of the following former vice-chancellors have been presented to the University of London, and have been framed and hung in the vice-chancellor's room: Sir John W. Lubbock, Sir John Shaw-Lefevre, Sir Edward Ryan, Sir George Jessel, Sir Julian Goldsmid, Sir John Lubbock (now Lord Avebury), Sir James Paget, Sir Henry Roscoe, Dr. A. Robertson (now bishop of Exeter) and Dr. P. H. Pye-Smith.

THE following fifteen men of science have been nominated by the council of the Royal Society for election to membership: Mr. E. C. C. Baly, Sir Thomas Barlow, Bart., Rev. E. W. Barnes, Dr. F. A. Bather, Sir Robert A. Hadfield, Mr. A. D. Hall, Dr. A. Harden, Mr. A. J. Jukes-Browne, Professor J. G. Kerr, Professor W. J. Lewis, Professor J. A. McClelland, Professor W. McFadden Orr, Dr. A. B. Rendle, Professor J. Lorrain Smith and Professor J. T. Wilson.

MR. J. G. BARTHOLOMEW, head of the Geographical Institute, the map house of Edinburgh, has been elected an honorary corresponding member of the Société de Géographie of Paris.

THE Smith's Prizes at Cambridge have been adjudged as follows: H. W. Turnbull, B.A., Trinity College, for his essay "The Irreducible Concomitants of Two Quadratics in *n* Variables"; G. N. Watson, B.A., Trinity College, for his essay "The Solution of the Homogeneous Linear Difference Equation of the Second Order, and its Applications to the Theory of Linear Differential Equations of Fuchsian Type."

DR. FREDERIK VAN EEDEN, of Amsterdam, who twenty years ago established a successful clinic for the mental treatment of disease, is at present in this country.

DR. HUBERT LYMAN CLARK has sailed for Jamaica to make collections on the reefs at Port Antonio.

AT the last meeting of the Middletown Scientific Association Dr. W. G. Cady, associate professor of physics at Wesleyan University, gave a lecture on "Electrical Oscillations."

THE Chicago Chapter of the Sigma Xi Society held its winter meeting on March 9. Professor W. L. Tower presented a paper on "Some Effects of Changed Environment upon Evolution Processes." Nine new members were admitted to the society.

THE Lowndean professor at Cambridge, Sir Robert Ball, F.R.S., lectured on "Ancient and Modern Views of the Constitution of the Milky Way" before the Cambridge Antiquarian Society on March 1.

SIR VICTOR HORSLEY will deliver the Linacre lecture at St. John's College, Cambridge, on

May 6, the subject of the lecture being the "Motor Area of the Brain."

Mr. Henry Bausch, second vice-president of the Bausch and Lomb Optical Company, and especially interested in the department of microscopes and scientific apparatus, died on March 2, at the age of fifty years.

Dr. Hermann Ebbinghaus, professor of philosophy at the University of Halle, founder and editor of the *Zeitschrift für Psychologie*, one of the most eminent German psychologists, has died at fifty-nine years of age.

The death is also announced of Professor Victor Egger, professor of philosophy and psychology at the Sorbonne, and distinguished chiefly by his work in psychology.

At the meeting of the National Academy of Sciences in April, 1908, as part of the movement for encouragement of cooperative research, a special committee was appointed on paleontological correlation consisting of Messrs. Walcott, Dall, Scott and Osborn. A grant of $500 was voted from the Bache Fund. As chairman of the section of vertebrate paleontology Professor Osborn has secured the cooperation of a number of foreign and American paleontologists, including Louis Dollo, of Brussels; Eberhard Fraas, of Stuttgart; Charles Depéret, of Lyons; Ernst Koken and F. von Huene, of Tubingen; S. W. Williston, of Chicago, and W. B. Scott, of Princeton. The council of the New York Academy of Sciences has voted to cooperate in this work by the publication of a series of correlation bulletins. The first bulletin now in press contains a report of progress for 1908. The author of the second bulletin is Professor Dollo, who covers the succession of vertebrates in Belgium. The third covers the work of Santiago Roth on the succession of mammalian horizons in Patagonia.

The U. S. Geological Survey in cooperation with the State Geological Survey has established at the College of Engineering, University of Illinois, Urbana, Illinois, a Mine Explosion and Mine Rescue Station. The purpose of the station is to interest mine operators and inspectors in the economic value of such modern appliances as the oxygen helmets and resuscitation apparatus as adjuncts to the normal equipment of mines. The station also will concern itself with the training of mine bosses and others in the use of such apparatus. Its service is to be rendered gratuitously, and so far as possible, to all in Illinois, Indiana, Michigan, west Kentucky, Iowa and Missouri. The formal opening of the station is to constitute a part of the proceedings of a fuel conference which is to be held at the University of Illinois from March 11 to 13.

On the first of March, Captain John Donnell Smith, of Baltimore, sent to the Smithsonian Institution the second consignment of his herbarium, consisting of more than seven thousand sheets of ferns. The entire herbarium, consisting of over one hundred thousand mounted plants, together with his botanical library of sixteen hundred volumes, was formally presented to the Institution in 1905.

A gift of £1,000 from Mr. C. F. Foster, and of a second £1,000 by Mrs. Rawlins, towards the intended new Archeological Museum, at Oxford, are announced. These sums, like further sums given by the Foster family, who have now subscribed £6,000, are given in memory of Mr. W. K. Foster.

It will probably be arranged that members taking part in the meetings of the British Association at Winnipeg from August 25 to September 1, may travel at the single fare rate of £7 11s. for the return journey between Quebec or Montreal and Winnipeg. This also applies to side trips in eastern Canada, the local single first-class fare being charged for the round trip, and it holds good for the round trip to points west of Winnipeg, the return ticket to the Pacific Coast points permitting members to return by the Crows' Nest Pass route.

A joint resolution passed both houses of congress authorizing the secretary of state to issue an invitation for the eighth International Congress of Applied Chemistry, to be held in this country. All the national societies interested in chemistry, educational institutions, corporations, etc., have been invited

to send delegates to a meeting to be held at the Chemists Club on April 3, to form an organization.

At a meeting of the business committee and the German members of the International Cancer Research Association, held at Berlin, on January 4, it was agreed, on the proposal of Professor von Czerny, to convene a conference on cancer at Brussels during the exhibition in that city. The final decision was left to the board of directors, which will meet during the session of the German Surgical Congress at Berlin, April 14 to 18.

It is expected that the Antarctic exploring steamer *Nimrod* will return to New Zealand at the end of March or the beginning of April. The headquarters of the expedition are at Lyttelton, the port of Canterbury, in the South Island, and that will be the *Nimrod's* destination when she comes out of the Antarctic regions. It is possible, however, that she will touch at a more southern port before reaching Lyttelton. She may put in at Half-moon Bay, in Stewart Island, off the southern coast of New Zealand, or at the Bluff, the southernmost port on the mainland.

The program of the Forest Club of the University of Nebraska for the second semester is as follows:

February 16—"The Commercial Forest Nursery," by Mr. L. O. Williams.

March 2—"Lumbering in Washington," by E. G. Polleys.

"Microscopic Study of Woods," by G. N. Lamb.

March 16—"Factors Affecting Stream Flow," by Dr. Condra.

March 30—"Formation of Forest Soil," by Professor Barber.

"Moisture Studies in Forest Soils," by Professor Keyser.

April 27—"Scientific Problems in Forest Plantations," by Professor Phillips.

May 11—"State Problems in Wisconsin," by A. G. Hamel.

"Utilization in Wisconsin," by J. C. Ketridge.

May 25—"Forest Types in the Philippines," by G. Pagaduan.

"Forest Utilization in the Philippines," by M. Lazo.

By signing the bill for the creation of the Calaveras National Forest, California, President Roosevelt has completed the legislative act which saves the most famous grove of trees in the world. The first Calaveras bill was introduced in the senate four years ago by Senator Perkins, of California. Bills for the same purpose were passed in the upper house of Congress a number of times, but failed of favorable consideration in the house. There is to be a practical exchange of the timber in the groves for stumpage on other forest land owned by the government. The land to be acquired under the bill includes about 960 acres in what is known as the North Calaveras Grove in Calaveras County, and 3,040 acres in the South Grove in Tuolumne County. The North Grove contains ninety-three giant sequoias and in the South Grove there are 1,380 big trees. Any tree under eighteen feet in circumference, or six feet through, is not considered in the count of large trees. Besides the giant sequoias there are hundreds of sugar pines and yellow pines of large proportions, ranging to the height of 275 feet and often attaining a diameter of eight to ten feet. There are also many white firs and incense cedars in the two tracts. The North Grove contains ten trees each having a diameter of twenty-five feet or over, and more then seventy having a diameter of fifteen to twenty-five feet. Most of the trees have been named, some for famous generals of the United States and others for statesmen and various states of the union. "The Father of the Forests," now down, is estimated by Hittel, in his "Resources of California," to have had a height of 450 feet and a diameter at the ground of more than forty feet when it was standing. "Massachusetts" contains 118,000 board feet of lumber; "Governor Stoneman" contains 108,000 board feet, and the "Mother of the Forest," burned in the terrible forest fire which licked its way into a part of the grove last summer, contains 105,000 board feet. Each of these trees named grows as much lumber as is grown ordinarily on fifteen or twenty acres of timberland. The bark runs from six inches to two feet in thickness.

IT is said that the Ohio State legislature once passed a bill establishing the value of π to accord with the views of some circle-squarer. It is perhaps scarcely fair to put in the same class the bill now before the British parliament. This bill "to promote the earlier use of daylight in certain months yearly"—formerly known shortly as the Daylight Saving Bill—is down for a second reading in the House of Commons. The operative clauses of the bill, as summarized in *Nature*, are as follows: (1) From two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in April* in each year until two o'clock in the morning, Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in September* in each year the local time shall be in the case of Great Britain one hour in advance of Greenwich mean time and in the case of Ireland one hour in advance of Dublin mean time, and from two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in September* in each year until two o'clock in the morning Greenwich mean time in the case of Great Britain, and Dublin mean time in the case of Ireland, of *the third Sunday in April* in each year the local time shall be in the case of Great Britain the same as Greenwich mean time and in the case of Ireland the same as Dublin mean time. (2) The time hereby established shall be known as summer season time in Great Britain and Ireland, and whenever any expression of time occurs in any Act of Parliament, deed, or other legal instrument, the time mentioned or referred to shall, unless it is otherwise specifically stated, be held in the case of Great Britain and Ireland to be summer season time as prescribed by this Act. (3) Greenwich mean time as used for the purposes of astronomy and navigation shall not be affected by this Act. (4) This Act shall apply to the United Kingdom of Great Britain and Ireland, and may be cited as the Summer Season Time (Great Britain and Ireland) Act, 1909.

THE Dove Marine Laboratory at Cullercoats, which is to be occupied as a department of the Armstrong College, Newcastle-on-Tyne, was opened on December 29 by the Duke of Northumberland. From the account in the London *Times* we learn that the new building, which stands on the site of the old baths, contains an aquarium 30 feet by 23 feet, and there are 11 fish tanks. There is also a private aquarium, and provision is made in 36 tanks for the storing of materials for the workers for experiments, hatching and the like. Against the west wall is a concrete tank holding 15,000 gallons of salt water, which will give a continual flow through the various tanks, etc. In the center of the west gable is the coat of arms of the Hudleston and Dove families, and a polished granite tablet near the entrance bears the inscription: "Erected A.D. 1908 by Walter H. Hudleston, M.A., F.R.S., for the furtherance of Marine Biology and as a Memorial of his Ancestress Eleanor Dove." Mr. W. H. Hudleston, the donor of the building, presided. The Duke of Northumberland congratulated the people of Cullercoats on the new laboratory. He said there was one at Plymouth, one at Port Erin, in the Isle of Man, one in Lancashire, and three in Scotland, and the new building opened that day enabled them to fill up the gap. If they were to study the habits of fish and to give advice to those engaged in the industry, it was absolutely necessary to have these laboratories scattered up and down the coast. The county council of Northumberland was willing to contribute £100 per annum to that institution. It was willing to do more and to double that amount if the borough of Tynemouth came forward and subscribed £50. The duke paid a tribute to the generosity of Mr. Hudleston and to Professor Meek, who is to have charge of the laboratory.

AT the thirty-first annual general meeting of the Institute of Chemistry, held at 30, Bloomsbury-square, W. C., Professor Percy F. Frankland, the retiring president, in the course of his address, said, as reported in the

London *Times*, that the roll of the institute had increased by 78 fellows, 30 associates and 68 students, and, notwithstanding the increasing stringency of the regulations, the number of candidates for examination had increased from 94 in 1906 to 150 in 1909. He believed these figures indicated that a real advance was taking place in the demand for highly-trained chemists. It was one of the chief duties of the institute to maintain a high level of training for professional chemists by demanding of candidates for its membership evidence of thorough training, and by requiring them to pass searching examinations. He yielded to no one in the advocacy of research as a part of training; there was however much training in originality of thought and experimental procedure which was not called research and much of what was called research that involved no originality in the thought or deed. He then stated that a special committee had been discussing the arrangements to be made in view of the approaching expiry of the lease of the present premises of the institute and had come to the conclusion that between £10,000 and £15,000 would have to be raised by voluntary contributions in order to provide even a modest but dignified home in which the institute could carry on its work. Dr. George Beilby, F.R.S., was elected president.

The Colorado Desert, in southern California, is one of the most interesting and one of the most nearly rainless parts of the United States. It lies in a wide valley, the northwest extension of the great depression at whose south end is the Gulf of California. Before the overflow of Colorado River into the Salton Sea, which began about five years ago, this basin was, with the exception of Death Valley, the lowest dry land in the United States. It is also the hottest place in the country, according to the official records. Parts of the desert are wastes of shifting sand, kept in almost constant motion by strong winds. Other parts, on the borders of the Salton Sea, contain strongly alkaline areas, and in some places now covered by that sea large quantities of salt have been mined. South of the Salton Sea, in the Imperial Valley, the soil consists of fine silt, deposited in past centuries from the overflowing waters of Colorado River. This part of the area is the scene of the spectacular and almost uncontrollable overflow which was the occasion of a special message from the President to Congress and which was closed after repeated failures only in 1907, by the Southern Pacific Company. Toward the north end of the valley in which this desert lies, for the most part below sea-level, is the Indio region, or the Coachella Valley, where underground waters have been utilized for irrigating several thousand acres of fertile land. Melons, barley and alfalfa are extensively grown on large areas, and smaller tracts have been planted in oranges, grapes, sweet potatoes and sugar beets. Date palms have been planted also, and on the agricultural experiment station farm at Mecca rare varieties of luscious dates, which heretofore have been produced only in the Arabian deserts and in the oases of northern Africa, are grown successfully. A report on the Indio region, including a sketch of the Colorado Desert, prepared by W. C. Mendenhall, has just been published by the U. S. Geological Survey as Water-supply Paper 225, which may be had free on application. The report includes a description of the geography and geology of the Colorado Desert and an account of the underground waters of the Indio region, and is illustrated by maps, sections and reproductions of photographs of interesting features of the country.

UNIVERSITY AND EDUCATIONAL NEWS

The passage of the legislative appropriation bill carrying $982,000 for the University of Kansas, gives the university all it asked, excepting an appropriation for a dormitory.

By the will of Ellen A. Kendall, her residuary estate is given Wellesley College to found a professorship bearing her name. It is provided that if the fund exceeds $60,000 the income of the excess shall be used to aid worthy students.

The final settlement of the estate of Archibald Henry Blount, of England, who sometime ago made Yale University his residuary legatee, shows that the university will receive net from the estate the sum of $328,752. In the settlement of the estate there has been paid out $8,539 for the university's legal expenses in the matter, and about $70,000 as an inheritance tax to the English Government.

The Ontario legislature has passed a resolution permitting Toronto University to take advantage of the Carnegie Foundation's pension fund. The legislature of Nebraska has refused permission to the state university.

It is announced that Columbia University will establish a course in forestry leading to the degree of forest engineer. The plan will probably be put into effect next year though the special work would not begin for two more years.

A bill has been introduced in the New York legislature amending the educational law by providing for the establishment of a State School of Sanitary Science and Public Health at Cornell University.

Three departments of Sibley College, Cornell University—those of marine engineering, naval architecture and railway mechanical engineering—have been discontinued. This action has been nearly coincident with the departure from Cornell of the heads of two of the departments, Professors C. C. Thomas and H. Wade Hibbard. But these professors did not go because their departments had been or were to be abolished, nor was their departure the cause of the termination.

The academy in Neuenburg, Switzerland, is to become a university.

The Egyptian government has in view the establishment of a national university. The theological students at Cairo have recently petitioned for competent teachers of modern science.

At a recent meeting of the faculty of Wesleyan University, two committees were appointed to act with those of the trustees. One in regard to the establishment of a separate college for women has Professors Rice, Winchester, Harrington, Nicolson and Bradley as members; the other, which will help fix the date of the inauguration of President Shanklin, consists of Professors Rice, Winchester and Crawford.

According to the *Umschau* there are this semester 1077 regularly matriculated women students in the German universities as compared with 140 three years ago.

At the meeting of the board of trustees of Stanford University, on March 5, the following promotions in rank to take effect with the beginning of the academic year 1909–10 were made: To the rank of professor: Frank Mace McFarland, in histology; John Flesher Newsom, in mining; Harold Heath, in zoology; Arthur Martin Cathcart and Wesley Newcomb Hohfeld, in law; James Farley McClelland, in mining engineering; Guido Hugo Marx, in machine design; Henry Waldgrave Stuart, in philosophy. To the rank of associate professor: Karl G. Rendtorff and William Alpha Cooper, in German; Lillian Jane Martin, in psychology; Raymond Macdonald Alden, in English; William Rankine Eckart, in mechanical engineering; Halcott Cadwalader Moreno and Sidney Dean Townley, in applied mathematics; Charles Andrews Huston and Joseph Walter Bingham, in law. To the rank of assistant professor: Payson Jackson Treat, in history; Mary Isabel McCracken and Rennie Wilbur Doane, in entomology; Walter Kenrick Fisher, in zoology; James Pearce Mitchell, in chemistry; Leonas Lancelot Burlingame, in botany.

Dr. R. S. Woodworth, adjunct professor of psychology in Columbia University, has been promoted to a professorship of psychology. Mr. H. H. Woodrow has been appointed tutor in psychology at Barnard College.

Dr. Ludwig Messer, associate professor of philosophy at Giessen, has accepted a call to the University at Buenos Ayres.

DISCUSSION AND CORRESPONDENCE

ADULTERATION AND THE CONDITION OF ANALYTICAL CHEMISTRY AMONG THE ANCIENTS

In an address of Mr. W. D. Richardson published in Science last year, attention is called

to the very speculative condition of ancient science. Mr. Richardson remarks that "Ancient records and books are extremely few in number, and worse than that, the scientific writings, when they are not purely speculative, are quite unreliable." This statement, while undoubtedly true, in a certain sense seems to me open to criticism in that it is apt to give one an entirely mistaken idea of what classic writers have recorded regarding the achievements of the ancients in practical chemistry. As a matter of fact, enough reliable practical chemical knowledge has come down to us in the writings of Pliny, Dioscorides and others to form a very respectable treatise. The "Natural History" of Pliny, for example, is completely interwoven with little digressions upon what is now termed the "chemistry of every-day life" and the reader is often surprised to run across statements, which might have been taken from some modern work, such, for example, as references to the use and well-recognized efficiency of burning sulphur for fumigating and purifying the interior of dwellings (book 25, ch. 50), or to the use of suspended cords upon which to crystallize substances (book 34, ch. 32), or to the lowering of a burning light into wine vats to determine whether or not it was safe for workmen to descend in order to remove the lees. "As long as the light refuses to burn it is significant of danger" (book 23, ch. 31). Pliny's book is filled with such little practical points as these, all of which, together with his description of many technical processes in which the Romans were recognized masters, such as the mixing of mortars and cement, the manufacture of white lead and other pigments, the fermentation of wine, the use of legumes in crop-rotation, etc., serve as a most striking commentary upon the manner in which the practise of a science may anticipate the dictates of its theory—even by thousands of years. Much of the matter which Pliny has gleaned in his "Natural History" was common knowledge centuries before his time. The use of burning sulphur as a disinfectant, for example, is mentioned in the "Odyssey" of Homer (book 22, ch. 481). Odysseus, after the murder of the suitors, cries out to his aged nurse: "Bring sulphur, old woman, the cleanser of pollution and bring me fire, that I may sulphur the chamber."

The science of the ancients was extremely weak, however, upon its analytic side and in the course of its whole history may be said to have produced but one mind truly great in this respect—that of Archimedes. This philosopher and experimenter by his method of displacement was the first to establish a physical constant—that of specific gravity—and the first to apply such a constant to certain analytical problems as in the well-known example cited by Vitruvius, where Archimedes determined the purity of the gold in King Hiero's votive crown.

The application of specific gravity to the testing of various bodies, liquid as well as solid, seems to have been common after the time of Archimedes. Pliny (book 31, ch. 23), in fact, alludes to the use of some form of specific gravity balance (Statera) by which the purity of water could be tested.

The search for a means to detect adulteration was what led Archimedes to his epoch-making discovery and this we will find to be always a leading stimulus in the development of analytical chemistry in ancient as well as in modern times. The adulteration of foods and other commodities of life was as common in the early days of the Roman Empire as it is to-day. Pliny repeatedly calls attention to the many frauds of his time. "It is the natural propensity of man to falsify and corrupt everything," he exclaims while writing of the adulteration of honey, and again, when speaking of the use of gypsum, pitch, lime, rosin, wood ashes, salt, sulphur, artificial pigments, etc., for treating wines (book 14, ch. 25), he cries out: "By such poisonous sophistications is this beverage compelled to suit our tastes, and then we are surprised that it is injurious in its effects!" Pliny blames the druggists especially for their practises in this respect and is most bitter in his denunciations of the whole fraternity of Roman apothecaries. Many pages of the "Naturalis Historia" are in fact devoted to the disclosure of the

"shady" practises carried out in the shops of the ancient druggists (tenebræ officinarum).

In the long list of tests, which Pliny enumerates for detecting the various forms of adulteration practised in his time, by far the greater number relate to the use of our simplest sense perceptions, such as taste, smell, color, feel, brittleness, etc. The ancients guided by such perceptions were unquestionably better judges of the purity of many articles of food than we are to-day. Pliny in fact, makes such a fine classification of tastes and flavors (book 15, ch. 32) that the translator finds himself at a loss for suitable terms in which to express the meaning. Whether this indicates an over-refinement of the taste perception among the Romans through the influence of a long line of epicures dating from Lucullus, or simply an atrophy of our present powers in this respect, would be difficult to say. Professional tasters (book 14, ch. 8) were in demand during the early days of the Roman empire to determine the quality of wines, and notwithstanding our advanced chemical knowledge of the score or more esters which give wines their characteristic bouquet, the final criterion in the judgment of a wine, now as in the days of Pliny, is the evidence of a skillful taster.

But the ancients had many other means of testing the purity of their commodities of life than those of simple taste and smell; and it is worth our while to examine a few of these, for they mark in reality the first beginnings in the development of the science of analytical chemistry. A good illustration of such tests is given under Pliny's description of Balsam (book 12, ch. 54).

Balsam in a genuine state should be quite hard, but when it is mixed with gum a brittle pellicle forms upon it. The fraud can also be detected by the taste and when placed upon hot coals it may easily be seen if there has been any adulteration with wax and rosin, for the flame in this case burns with a blacker smoke than when the balsam is pure. In addition to these various tests a drop of pure balsam, if placed in luke-warm water, will settle to the bottom of the vessel, whereas, if it is adulterated it will float upon the surface like oil, and if it has been drugged with metopion or ammoniacum, a white circle will form around it. But the best test of all is, that it will cause milk to curdle, and leave no stain upon cloth.

Such tests as the ones cited in this quotation show that the faculty of careful and precise observation was by no means neglected among the ancients.

The flame test to which reference was made, is mentioned repeatedly by Pliny in the testing of drugs and chemicals. In some cases the color and smell of the smoke were observed, in others the color of the flame, or the property of decrepitating.

The formation of a white ring as described by Pliny in his test for adulterated balsam, brings up to the mind of the chemist the innumerable ring tests which are made use of in the laboratory at the present day, as well as the host of color reactions employed in testing food products, drugs and chemicals. We find, in fact, that these color reactions were used very extensively by the ancients, and the mention of one or two others may have a passing interest.

Among the tests given for alum Pliny (book 35, ch. 52) states that it will turn pomegranate juice and nut galls black. Authorities differ somewhat as to the exact nature of the compound that was called alumen by the Romans and στυπτηρία by the Greeks, but all seem agreed that sulphate of iron was present. The tests which Pliny describes are therefore nothing but the familiar tannin reaction with salts of iron.

A most interesting modification of the nut-gall test is described under the subject of verdigris (book 34, ch. 26). Here a piece of papyrus, which had been previously steeped in an infusion of nut galls, is employed for testing, the paper so treated turning black if genuine verdigris is applied. This passage is noteworthy, for so far as I can find it is the first historical reference to the use of test paper.

In a number of instances I have found Pliny to be even wiser than his modern commentators. Pliny gives, for example, as one of the tests for vinegar (book 23, ch. 27) that it has the property of effervescing when poured upon the ground. The editor of one

translation remarks as to this that the vinegar of the present day does not have any such property. If this commentator, however, had had even a little knowledge of chemistry, he might have remembered that the acid of vinegar may cause a considerable effervescence of carbonic acid when brought into contact with chalky or calcareous soils.

In testing the purity of minerals and precious stones the ancients seem to have acquired considerable dexterity. The use of the touch-stone (Coticula) for determining the purity of precious metals and their ores was well known to the Romans and employed with such accuracy, according to Pliny (book 33, ch. 43), that the *proportion of gold, silver or* copper could be told instantly, even to the smallest fraction. In detecting the imitation of gems and precious stones—concerning which Pliny (book 37, ch. 75) states that most colossal deceptions were practised and in no other kind of fraud greater profits made—the ancients were in many ways as skillful as the jewelers of to-day. They employed the balance, tested certain optical properties, and even used a scale of hardness (book 37, ch. 76), it being recognized that some stones could be scratched with a blunt knife, while others could not be marked with the hardest obsidian.

Lack of space forbids giving other examples of the methods employed by the ancients in testing the purity of the commodities of life. The examples cited however show that the fragmentary records of ancient science preserved by Pliny, full as they are of inaccuracies and absurdities, contain a large amount of reliable chemical knowledge. And if the 474 authors whom Pliny consulted in the preparation of his "History" had come down to us intact we may be sure that our knowledge not only of historical, but also of practical, chemistry would be greatly enriched.

C. A. Browne

New York

EVOLUTIONARY COLLECTIONS AS MONUMENTS TO DARWIN

To the Editor of Science: In connection with the recent announcements that special collections in honor of Darwin are to be formed at the American Museum of Natural History, and that Haeckel intends to devote the remainder of his life to his phylogenetic museum, I venture to call attention to the subjoined selections from my address, "Educational Museums of Vertebrates," before the Biologic Section of the American Association for the Advancement of Science in 1885 (see the *Proceedings*, vol. 34, and abstract in Science, September 11, 1885):

A statue of Darwin has been unveiled in London with honorable ceremonies. What monument to his memory could be more appropriate or lasting than the formation, in all educational institutions, of collections especially designed to exhibit the facts which he made significant, and the ideas which his knowledge, his industry and his honesty have caused to underlie the intelligent study of nature throughout the world. Such collections should particularly embrace series illustrating human peculiarities, not only as to skeleton, but as to brain, heart and other organs; human resemblances to mammals in general; features that unite man with the tailless apes, and separate them from all other mammals; transitory human organs and conditions that resemble the permanent organs and conditions of other mammals, especially apes; human anomalies resembling the normal structure of apes; anomalies and malformations affecting man and other vertebrates in a similar manner; apparently useless or detrimental organs or conditions.

Burt G. Wilder

Ithaca, N. Y.,
February 13, 1909

QUOTATIONS

THE FUTURE OF YALE

If I were president of Yale! But that is inconceivable. I was never in the hereditary line of descent. Besides I stepped out of all other lines that tend toward New Haven when, forty years ago, after getting more or less ready for Yale, I went as a pioneer to untried Cornell. I went because botany and geology and European history at Cornell counted for as much as Latin or Greek; and now I have to take the consequences.

If I were president of Yale, and had the necessary power and the necessary backing, this I would surely do. I would make it Yale College or else Yale University. For the questions would lie heavily on my conscience —Should a boy go to a university for college work? Should a man go to a college for university work? Should a school for boys try to teach also men? Should a school for men teach also boys, under the same conditions and regulations, and with the same teachers?

I read not long since a well-written book, "What College for the Boy?" In this volume, Yale College receives favorable mention, and most justly. Can I imagine a cognate volume in Germany? "Welche Universität fur den Knaben?" The very title is absurd on the face of it, for the place of "Knabe" is not in the "Universität." Conversely, the function of a university is not to teach the boy but the man.

The name "university" has in Germany and in continental Europe a fairly definite meaning. In America, it means nothing in particular, except a higher school, higher than the high school. In England it often means still less—an examining board authorized to confer degrees. Let us take the German meaning—a school for men, who have finished their general culture, have ceased to be boys, and have begun preparations for life work as professional men, as teachers or as investigators. This is the meaning Johns Hopkins has brought to America, and which is recognized as a valuable but exotic attachment at Harvard, at Yale and with the rest of us.

On the other hand, we have adopted the English term "college" for a group of schools progressively diverging from the English standards, but which agree in this. Their first function is to make men out of boys, and to secure the boys' cooperation and interest in the process. Where this is best done is in the "college for the boy." Where the demands of scholarship are most strenuous, where expeditions are constantly undertaken for the conquest of the unknown, where books, apparatus and collections are greatest, that is the university for the man.

In this transition stage, we have lost sight of both ideals. Rather, we behold one of them for a time, then the other, and we rush like a school of herrings toward the light that we see for the moment.

A few years ago, almost every college pretended to be a university. Almost every college teacher thought himself engaged in research and pretended to hold in contempt the "boy" and all his own duties toward the boy. So the boy became estranged from his work, and made trouble. Thus the college ideals are again insistent. Good teaching is again the demand, and the tireless attention to details that make boy-training possible, and which shut out the teacher from research of any intensive character.

All honor to the college teacher who in all these years has never lost his head, and who has steadily, consistently and without self-compromise done his duty in making boys into men. He finds them just as plastic as they ever were, and his reward as ever is in the doing.

All honor to the university teacher who abates none of his ideals, who sees the universe with a keener eye than the rest of us, and who never forgets his first duty as a seer, a prophet, a founder of a school of thought, a leader of men.

The college and the university are here, are here to stay, and here to grow and develop; but not in the same space, and still less as, at present, telescoped together. Sooner or later, we must recognize the two different functions. Sooner or later we must see that the college with its boy's play, its foot-ball team, its glee club, its need of personal inspiration, its need of rigorous moral discipline, its need of absolute inhibition of vinous conviviality, its demand for insistent training rules to prevent grafting and dissipation, is an end in itself. The glory of Yale has been that of Yale College, and Yale will have fulfilled all that a nation can ask of it if it makes Yale College the culmination of its activities. Or, Yale University may be the glory of the future—the thorough professional and technical training of men already broad-minded, clean-souled, and well-

grounded in all that the college can give in its four years of fellowship, aspiration and discipline. (These four years ought to end as they did thirty years ago, with the year we now call "sophomore," but that is another story.) But Yale College and Yale University, all together and equally great, that can never be.

Yale University needs books, apparatus, collections, long-striding scholars and founders of dynasties of scholarship and research. Yale University needs millions; Yale College has enough. But Yale College and Yale University in one yard, under one body of teachers, under one set of discipline, and forever getting in each other's way; this condition can never be a finality. Until they are separated in space, as in time, Yale College can not escape the reproach all our colleges bear, that she neglects her boys in the imagined interest of research; that her professors do not love their work, and slight it in many ways; that if the boy becomes a man the college deserves no thanks for it.[1] On the other hand, Yale University will find itself blamed for contributing so little to the advance of knowledge. With a staff as large as that of Leipzig, more or less, and an equivalent student body, its scholarly output is less than half that of the German institution. This sort of criticism we hear again and again. Whether this be just or not is a minor question. People think that it is true, and it will be essentially true so long as Yale College is interchangeable with Yale University.

Were I president of Yale, I would cling to the one ideal or the other, letting all else go. For the time must come when our colleges can not fulfill our university ideals, by adding scantily equipped professional schools and hiring a dozen or two graduate students to shift for themselves under overworked professors. Meanwhile, our universities can not make men out of boys unless they address themselves most seriously to the business, "bringing every ray of various genius to their hospitable halls" that through their united influence "they may set the heart of the youth in flame."

You will see that this applies to Yale no more and no less than to Harvard, to Cornell, to Wisconsin and to any other institution which is trying to do boy's work and man's work at the same time, in the same place, and by the same educational machinery. We have just now referred to the University of Leipzig. Let us suppose that to her three thousand students, more or less, she should add as many more from the higher grades of the gymnasium or high school, corresponding to our freshmen and sophomores. Let us suppose that she should add to her faculty of three

[1] Says Dr. George E. Vincent, a dean of the University of Chicago: "The chief causes which are alleged to be responsible for a perceptible lowering of the standard of student work are: less definite and disciplinary instruction in the elementary and secondary schools; an elective system permitting a haphazard, desultory, individual course; the presence of an idle rich class setting a standard of ostentation and luxury; the exaltation of competitive athletics and the heroizing of successful athletes; the growth of fraternities with their time-consuming activities and social distinctions; the emphasis on social life and the consequent prejudice against the diligent student who takes little part in the 'valuable education outside the classroom'; the over-crowding of classes so that attention to individual students is difficult or impossible; the introduction of the lecture system for undergraduates accustomed to the drill of the recitation method; the putting of young, inexperienced, overworked and illpaid instructors in charge of freshmen and sophomore divisions; the competition between instructors in offering popular, largely elected, and too often 'snap' or 'soft' courses; the exaltation of research at the expense of 'mere teaching' and the consequent lowering of teaching efficiency; the extension of the doctrine of freedom of teaching to protect a careless or inefficient instructor of elementary courses from investigation; failure to make college work seem vital to the student, a means to his personal ends, in marked contrast with the success of the professional schools which hold up a definite goal, arouse interest and enforce a higher standard of effort and accomplishment. The mere enumeration of these charges raises many questions of fact and interpretation. That some if not all of the influences are present in all of our colleges is not to be denied."

hundred professors, more or less, as many gymnasium drill masters. Let us suppose that the resultant multitude were called a university. It would be just the same sort of a university we have developed in America, a place where men and boys are gathered together, each in the other's way, and where neither ideals of scholarship nor ideals of man-making can reach their most perfect achievement.—President David Starr Jordan, in *The Yale News*.

SCIENTIFIC BOOKS

Conditions of Life in the Sea. A Short Account of Quantitative Marine Biological Research. By JAMES JOHNSTONE. Pp. 332. Cambridge Biological Series, Cambridge University Press. 1908.

Many good things must be, and a few bad things ought to be, said about this book. Since it is more agreeable to speak well than ill, we will occupy ourselves first and chiefly with what is good.

The broader value of the work is two fold.

In the first place it affords an easy, reliable opening into an important, rapidly growing field of knowledge that hitherto has not been readily accessible to general readers, nor indeed to special scientific students. The field to which reference is made is marine biology as developed particularly by the countries bordering on the North Sea. Many professional biologists, especially in America, have not yet had brought home to them the fundamental nature of various conceptions and methods involved in these investigations.

In the second place the book is noteworthy for biology generally from the consistency with which the quantitative standpoint is maintained. The reviewer does not recall another semi-popular work in which organisms are regarded in a quantitative way for so wide a range of their relationships. In this the book may be looked upon as a harbinger of what biological treatises of general character will be in the future. This statement tells at once that the author is enrolled in the so-called Hensen or Kiel school of marine biologists.

Much criticism has been passed upon both the methods and results of this school. One may be indeed justifiably sceptical concerning the value of the particular calculation that a square mile of the water of the Baltic Sea contains 80 to 100 billion copepods, or that there were 180,139,000 haddock in the whole North Sea during the spring of 1895. The chief interest in the calculation lies in its significance concerning what biology's attitude toward its problems may be. In a given limited area of the ocean, the North Sea for example, there is at a given time *some* limited number of haddock. Finite quantities of substances and bodies and forces are the very foundation stones of all physical science, biology with the rest, and sooner or later as knowledge advances, values for these quantities are bound to be sought. When fishing industries unite with clearly perceived biological problems in demanding information as to how many herring there are in the North Sea, and how much food is available for them, to get such information is exactly part of the business of science. If the first attempts are not sufficiently reliable, others with better methods must be made. For biology to take the ground that such researches can not be successful, nor would be significant if they were, would be to acknowledge itself stunted in its early youth.

The book is divided into three parts. Part I. designated introductory, contains in the first place a general description of the apparatus and procedures used in the most advanced marine biological researches. An account of certain aspects of oceanography is also given as is a very general survey of the Life of the Sea. Such topics as bottom deposits, composition, temperature, transparency and circulation of the waters are touched upon.

Under the heading Life in the Sea the zones of littoral life, bottom dwellers, or the benthos, and the free life, or the nekton and plankton, and kindred subjects are spoken of and several figures showing characteristic pelagic invertebrates and algæ are given. This part ends with a chapter on sea fisheries.

The real essence of the volume is in parts II. and III., designated respectively Quanti-

tative Marine Biology and Metabolism of the Sea. Part II. is, on the whole, the most satisfactory portion of the book. The author is at his best when dealing with actual observations and matters of fact in such a way that his general biological theories have no visible influence on his conclusions, and it is unfortunate that the whole book could not have been written with a mind thus unhampered.

Although Mr. Johnstone's adherence to the Hensen ideas is unqualified it is not slavish. Most, though by no means all, of the more telling criticisms passed upon the methods and results of the Kiel school are duly heeded. The methods of collecting developed up to date are treated to the extent of nearly ten pages, and Lohmann's interesting observations on the capture of plankton by appendicularia is adequately noticed. The four methods of estimating the quantity of plankton, viz., the volumetric, chemical, gravimetric and numerical, are considered both as to processes and reliability. Of these "the actual counting of the organisms is the most satisfactory."

The surface distribution of certain kinds of planktonic organisms in the north Atlantic is illustrated chiefly by reference to Cleve's work. Two instructive charts accompany this discussion.

A chapter devoted to A Census of the Sea, and another on The Productivity of the Sea, summarizes considerable of the data on these subjects, though by no means all that has been gathered by the investigators of the north Atlantic.

On the question of the depletion of the sea through fishing, the author, though admitting the absence of conclusive proof on either side, and noting the authoritative opinion against exhaustion, thinks "we can not come to any other conclusion than that fishing operations as at present carried on, do cause a very appreciable diminution of the stock of fish on the sea bottom." More reliance is placed on Hensen's investigations than on any others for this conclusion.

Greater productivity of the ocean in high latitudes than in low is regarded by the author as proved. The three chief explanations of this supposed fact are considered in part III. Brandt's conjecture that denitrifying bacteria are more active in warmer waters and hence prevent these from containing as ample a supply of nitrogenous food-salts for the phyto-plankton as the colder waters have, is held to be "not the only hypothesis capable of explaining" the phenomenon. Nathanson has suggested that in some localities at least, colder waters may contain greater quantities of organic matter because they have up-welled from the bottom or deeper water where such matter has gradually accumulated through the settling into them of the carcases of organisms that have lived in the lighter waters above; or through the transferrence to them by convection-currents of warmer surface water from middle latitudes that have been enriched in organic matter by rivers from land areas clothed with vegetation of tropical luxuriance. Johnstone thinks this hypothesis worthy of consideration.

Finally the explanation proposed by Pütter is presented. This author supposed, to state the case in a nutshell, that animals inhabiting warm waters live faster than those inhabiting cold waters and so consume more food. Consequently since the food supply is everywhere limited, a less numerous population can be maintained in the warmer than in the colder seas.

Among the many interesting subjects treated in part III., none is more interesting than that of nitrogen in the sea and the relation of bacteria to this element.

That imagination would be dull indeed that should not be kindled by the picture outlined in this part of the book of what the earth really is as a habitation for living beings. The truly cosmic character of the problems the threshold of which has been crossed by Brandt and the few other foremost investigators in this realm, is well brought home to the reader.

The book ends with several useful appendices, one of which is a summary of A. B. Macallum's interesting though not convincing speculations on the chemistry of the early seas, and the impress this has left on living beings down to even the present.

It remains now to point out certain really bad defects in the work. In the first place the title is misleading. From it a prospective reader would anticipate a comprehensive treatise—comprehensive, that is, in the sense of reaching to the seas of the earth generally. As a matter of fact the only indication the book contains that the author knows of the existence of oceans beyond that contiguous to northwestern Europe is just enough reference to others to impress the reader with the idea that whatever such there chance to be, may be ignored, except so far as they illustrate the central truths, truths, that is, that center in the North Sea. Think, for instance, of a discussion of "The Productivity of the Sea" that does not mention the cod-fisheries of Newfoundland, the salmon-fisheries of Alaska, and the fisheries generally of Japan and China!

How shall a professedly general treatment of the problem of the depletion of the sea be characterized that makes no reference to the Alaskan salmon hatcheries or to the perennial effort to save from destruction the fur-seal herds of the Behring Sea?

Had the author taken as his title "Conditions of Life in the *North Sea*" or something of the sort, he would have saved himself from the grave criticism that must now be passed upon him. Any moderately informed reader will surely ask: Does the author not know what has been and is being done in other parts of the world on many of the problems considered, or knowing does he deliberately ignore? Desiring to be fair which alternative shall we reject as being the less creditable?

Is an author's deficiency professional or ethical, which permits him to discuss in a general book the "Stratifications of the Plankton" and make no reference to the work of Alexander Agassiz?

Professor W. A. Herdman and his colleagues of the Marine Biological Association of Liverpool have contributed importantly to the knowledge of the sea and its life, particularly of the western British seas. Does Mr. Johnstone find nothing here deserving mention beyond the fact of footnote value (p. 191), that Herdman has made "some interesting suggestions as to the use of copepoda as human food?"

Wherefore the book's deficiency in the use of accumulated knowledge? The candid, measurably informed reader is forced to this question over and over again.

Some of the chapters were turned over to the printer while their English was yet sorely in need of pruning and finishing.

On account of the limited amount of food yolk development is a rapid process and the little fish usually hatches out from the egg in a week or two, but is a very feeble and helpless creature (p. 83). (*37 words.*)

On account of the limited food-yolk development is rapid and the little fish usually hatches in a week or two, but is very feeble and helpless. (*27 words.*)

Ten useless words in thirty-seven are too many. They make twenty-seven per cent. of superfluity. On the score of mere physical loading this is unfair to the printer, the purchaser and the reader, to say nothing of the writer. Furthermore, there are the literary proprieties. Surely they deserve some consideration even at the hands of the scientific man. True no great number of sentences are as hypertrophied as is this, but it is by no means unique and those that approach it are not rare.

Despite these unsavory remarks brought upon itself, the book's merits far outweigh its defects. All English speaking people interested in the larger aspects of marine biology should feel grateful to Mr. Johnstone for having written it even though they can hardly help wishing he might have made it better in some respects.

WM. E. RITTER

Manual of Practical Assaying. By the late H. VAN F. FURMAN, E.M. Revised and enlarged by WILLIAM D. PARDOE, A.M., Assistant in Mineralogy, Princeton University. Cloth, 8vo. Pp. xi + 497. Price $3.00.

It was most gratifying to find that this book, which has been considered as a standard, and had been used extensively as a text-

book in nearly all our universities, was not to be permanently laid on the shelf. The friends of Professor Furman heard of his demise with the deepest regret, and it was with the greatest of pleasure that the writer learned that a lasting monument to his name was to be erected through the publishing of a sixth edition on "Assaying," revised and enlarged by Mr. W. D. Pardoe.

This book has been, and will continue to be, the standard on assaying for technical chemists, and for students in the universities which have a mining, metallurgical or any course on the quantitative determination of metals and their associated elements.

The aim of the author was to present to technical chemists and students of chemistry a *practical* book. That he succeeded is demonstrated fully by the demand for a sixth edition. In this book only the most approved methods of analysis have been chosen, and particular attention has been paid to rapid methods which are so indispensable to technical chemists employed on commercial enterprises. At the same time slower and more accurate methods are nearly always given, so that the analyst can use either, according to the dictates of the time at his disposal.

By the revision of the chapters on zinc, water and coal analyses, and the addition of methods for telluride ores, tungsten, molybdenum and vanadium, together with other minor changes, this book has been most thoroughly brought up to the present practise common in most of our large commercial laboratories.

The whole book is singularly free from lengthy theoretical discussions of the reactions taking place, but enough of the reasons "why" are given to enable the trained chemist to understand fully the methods he is pursuing. At the same time the chemist's assistant who may lack a college training can easily pick up "Assaying" and do good work if he follows carefully the very explicit directions.

If the writer may be allowed a word of friendly criticism, since the text is very clear and leaves little to be improved upon, it would seem in some cases as though this text could have been supplemented to a very great advantage to the student if more diagrams and illustrations of apparatus had been interpolated. For example, a picture or diagram of the quite complicated apparatus, such as is used for the determination of total carbon in the analysis of iron and steel, would go a long way toward helping the beginner in quantitative analysis to fully understand its setting up.

But taken altogether, the book is most admirably adapted for the teaching of assaying in a practical way, and is a most desirable addition to the chemist's library, be he beginner or an expert.

HENRY C. BOYNTON

TRENTON, N. J.

A Study of Splashes. By A. M. WORTHINGTON. With 197 illustrations from instantaneous photographs. London and New York, Longmans Green & Co.

"This publication," as the author says in his preface, "is an attempt to present in a form acceptable to the general reader the outcome of an inquiry, conducted by the aid of instantaneous photography, which was begun about fourteen years ago. . . ."

Every observant person must have at some time or other been impressed with the curious appearance of the splashes produced by rain drops falling into still water: the small pits or craters with little fountains in their centers, which sometimes rise above the surface to the height of an inch or more, can hardly fail to have attracted the attention of every one. In this book we find a collection of some of the most interesting photographs ever obtained by the aid of instantaneous photography. It is a volume of interest to old and young alike, and should be in the hands of every boy interested in natural phenomena. Some of the phenomena recorded by the instantaneous flash of the electric spark can be seen by ordinary eye observation. If a drop of milk is allowed to fall from a height of fifteen inches into a cup of tea or coffee, to which milk has not been added, observation shows us that the white drop appears to penetrate a short distance.

into the dark liquid and then bounce out again. To find out what really happens we have only to inspect the photographs of the drop as it enters the liquid. It forms a hollow bowl or crater six or eight times its own size (in diameter), the milk flowing up the steep sides in radial streams; surface tension then pulls down the walls of the crater, the milk streaming back from all sides towards the center of the crater from which a fountain rises, carrying the reconstructed milk drop upon its summit.

Even more interesting is the study of the difference in the nature of the splash in the case of a highly polished marble and one which has had its surface roughened with sand paper. In the former case we have what Worthington has named the "sheath" splash, which is characterized by a very curious flowing up of the liquid around the surface of the sphere as it enters the water, the marble entering the liquid with little or no sound and the production of no bubbles. If the surface is roughened the liquid does not glide up the surface but shoots off tangentially to the sides, forming the "basket" splash, which is distinctly audible, and is followed by a violent bubbling of the liquid. The author advises every one to have a bag of marbles hung up in the bath-room, and repeat these experiments in the bath-tub. In addition to the wonderfully interesting photographs there is much valuable and entertaining descriptive matter, and the theory of the phenomenon of the splash is very fully discussed in its relation to surface tension, gravity, viscosity of the fluid, etc.

As the author points out a kinetoscope capable of securing a continuous series of pictures showing all of the various phases of a single splash is much to be desired. Such an instrument ought not to be difficult to construct. It would not be necessary to have the film brought to rest for each exposure, as is the case in the ordinary instrument, provided the illumination was effected by properly timed electric sparks. The most interesting stages of the phenomena are over in about two tenths of a second, and it would be necessary to secure about one hundred photographs during this space of time. When run through the machine at the rate of seven per second we should have a quarter of a minute to study the phenomenon. The sparks could be timed by putting a make and break in the primary circuit of an induction coil, so arranged as to be operated by the mechanism which carried the film along.

R. W. WOOD

SPECIAL ARTICLES

A NOTE CONCERNING INHERITANCE IN SWEET CORN

IN the polymorphic species, *Zea mays* L., the sweet corns, called *Zea saccharata* by Sturtevant, have been considered as a single subspecies group characterized by a hard, translucent and more or less shriveled condition of the endosperm. Correns[1] has shown that this character is due simply to an inability to complete the formation of normal maize starch, and further, that the presence and absence of this starch-forming ability act as an independent character pair in inheritance. No other feature is peculiar to the group: varieties characterized by black aleurone cells, red pericarp, yellow endosperm and the other salient points common to dent and to flint corns, are all found in the sweet corns. Their claim as a subspecies group thus rests entirely on the first-mentioned character.

The following evidence, however, indicates that sweet corn varieties do not belong to a unit group, but consist both of dent corns and of flint corns which have lost their original starch-forming power. This condition may have come about through mutation in each of these groups, but from what we know of the early history of the sweet corns, it is more likely that the change took place among the flint types and was extended by hybridization.

The dent corns are distinguished by a corneous starchy part of the endosperm which lies at the sides of the kernel and surrounds

[1] Correns, C., "Bastarde zwischen Maisrassen mit besonderer Berücksichtigung der Xenien," *Bibliotheca Botanica*, 1901.

a zone of white starchy matter extending from the tip to the cap, where it forms a layer varying in thickness in different varieties. The shrinkage of this cap starch forms the indentation of the kernel. In the flint corns this soft starch at the cap is replaced by corneous starch, thereby giving the outer portion of the kernel a smooth appearance. Besides this absolute difference, most dent and flint varieties differ in other characters, although a few intergrading strains are found. In the first place, dent corns are found that possess from twelve to twenty-eight rows of kernels, while the older flint types have but eight rows. It is true that there are genuine dents and true flints that tend toward the production of twelve rows, but below this number with the dents, and above it with the flints, continual reversions indicate a hybrid condition. Dent corns are little given to tillering, while with flint corns it is characteristic. This trait is partly a physiological reaction due to the greater amount of soil fertility required by the large main stalk of the dent varieties, and partly an inherent trait capable of hereditary transmission. Flint corns are further characterized by the manner in which the ends of the spathaceous bracts (husks) enclosing the pistillate flowers are expanded into leafy parts from one to two feet long. In the dent corns these appendages are absent or only slightly developed.

The bearing of these opposite features in the dent and the flint corns on the matter in hand, is that *sweet corn with its numerous varieties runs the whole gamut of these characters.* Stowell's Evergreen, a large sweet variety with from sixteen to twenty-four rows, is an example of a "dent" sweet corn, while the Golden Bantam and Black Mexican, two small eight-rowed varieties, are examples of "flint" sweet corns. These varieties are typically dent and flints, respectively, in every character except starchiness. Moreover, when the character of starchiness is brought into kernels of these varieties by pollination with *either* dent or flint pollen, the hybrid kernels formed are indistinguishable from pure dent and pure flint kernels, respectively. It seems to make no difference with either variety whether dent or flint pollen is used, for, although the starchy character appears in the individual kernel as zenia through double fertilization, the dent and flint characters appear to be largely—I do not say entirely—determined by the plant character possessed by the female parent.

To determine whether Black Mexican sweet corn carries the "flint" character even though it has no "starch" character, it was crossed on a white dent variety. Both types were pedigreed corns; that is, they had been grown in isolated plots for at least five years, consequently they may be considered to have been pure. To remove all doubt on this point, however, kernels from the same ears that produced the plants that were crossed were inbred. The inbred ears all proved to be true to their respective characters.

The F_1 generation of this cross, although it showed the regular Mendelian ratio of starchy and non-starchy kernels, consisted both of dent and of flint ears. Neither the flint character nor the dent character was dominant, hence the appearance of the two types. We are forced to the conclusion that the flint character was brought into the combination by the sweet corn parent, and became manifest when it met the "starch" character of the dent corn parent. In like manner Stowell's Evergreen was shown to carry the "dent" character, by crossing with an eight-rowed starchy flint variety. The F_1 generation contained several dent ears which could only have been produced by the "starch" character of the flint variety meeting the "dent" character of the sweet variety.

It is evident that the internal structure of the corn kernel is based upon several unit characters. There are different patterns of corneous starch which produce pop, flint, dent and starchy varieties. These units seem to be partly independent and partly dependent on starchiness and on shapes of pericarp.

It may also be noted that evidence is accumulating that the above facts regarding sweet corn are largely accountable for the marked superiority in sweetness of most small sweet corn varieties. The "dent" sweet va-

rieties require a longer time between pollination and the date they reach table condition than do the "flint" sweet varieties; and during this time the former kinds appear to change more of their carbohydrate compounds to starch.

E. M. EAST

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION B—PHYSICS

THE annual meeting of the American Association for the Advancement of Science, Section B, was held in the Physical Laboratory of the Johns Hopkins University, at Baltimore, December 28–31, 1908. This was a joint meeting with the American Physical Society. Each organization held a short session for the transaction of routine business, but the eight sessions for the reading of papers were joint meetings of the two societies.

The presiding officers were Professor Karl E. Guthe, vice-president and chairman of Section B, and Professor Edward L. Nichols, president of the American Physical Society. Professor F. E. Nipher was elected a member of the council, Professor G. F. Hull, of the sectional committee, and Dr. L. A. Bauer, a member of the general committee.

The officers for the next annual meeting, to be held in Boston during the convocation week of 1909–10 are as follows:

Vice-president and Chairman of Section B—Dr. L. A. Bauer.

Retiring Vice-president—Karl E. Guthe.

Members of the Sectional Committee—K. E. Guthe, L. A. Bauer, A. D. Cole, E. L. Nichols, A. Trowbridge, E. B. Rosa, A. P. Carman, G. F. Hull.

In the afternoon of Tuesday, December 29, Professor Dayton C. Miller delivered an address, as retiring chairman of Section B, on "The Influence of the Material of Wind Instruments on the Tone Quality." This has been published in full in SCIENCE, January 29, 1909. It was heard with great interest by a fine audience of about one hundred and fifty. The other seven sessions were attended by from forty to one hundred persons, with an average attendance of about seventy. That on Wednesday forenoon was devoted to subjects of somewhat general interest and papers by Hayford, More and Bauer of the following program were given at that time.

The hotel headquarters for physicists proved a useful and enjoyable feature of the meetings. Hotel Kernan proved a pleasant gathering place and a large proportion of the visiting physicists were registered here. The most successful social event was the subscription dinner for Section B and the Physical Society, held on Tuesday evening at the Country Club. This was attended by about ninety and was generally declared to be the most successful social gathering of American physicists ever held. The success of the occasion was principally due to the care and zeal of Professor J. S. Ames, of Johns Hopkins University.

The titles and abstracts of the fifty-two papers presented at the several joint sessions are given below.

Fatigue of Metals Excited by Röntgen Rays: LOUIS T. MORE and R. E. C. GOWDY, University of Cincinnati.

The work is a continuation of the results previously obtained in the same subject and reported at the Chicago meeting of the American Association for the Advancement of Science (see also *Phil. Mag.*, 1907). A new method has been devised for measuring the secondary radiation given off by metals bombarded by X-rays. Previous results have been confirmed and extended.

To account for the secondary radiation, Professor J. J. Thomson has advanced the theory that the X-rays cause a disintegration of the metal and permit the expulsion of charged corpuscles. Our experiments make this theory doubtful. Iron, lead and copper plates with pure surfaces were used and then the plates were coated with thin films of the lower oxides of the metal and again with films of the higher oxides. The effect of this successive oxidation on the fatigue seems to show that chemical changes of the surface produced by the X-rays with the consequent changes of surface-electrified double layers, will account for the phenomena observed.

Errors in Magnetic Testing of Ring Specimens: M. G. LLOYD, Bureau of Standards, Washington.

This paper is mainly theoretical in character. Formulas are derived connecting the mean magnetizing force with the magnetizing force at the mean radius, and the actual hysteresis loss with the loss which would occur with uniform distribution of flux. Tables and curves illustrate the errors involved and serve to give the necessary corrections in particular cases.

Some Data regarding Recent Magnetic Storms: L. A. Bauer, Carnegie Institution, Washington.

Renewed interest was recently shown in magnetic storms on account of severe ones last August and September and because of Hale's discovery of the Zeeman magnetic effect in sun-spots. Some concluded that a true explanation of the origin of terrestrial magnetic storms had been found. However, a simple calculation shows that the magnetic field intensity observed in sun-spots is totally inadequate to affect the most sensitive magnetic instruments. Whereas the effects actually observed during storms exceed many times—in fact a hundred fold and more—the limit of measurement (about 1/100,000 C.G.S unit). Little progress has been made in the solution of the problems presented by magnetic storms, one reason being that the investigations to be thorough are beyond the power of the average individual. They must, hence, generally be restricted either to one particular phase or to one element—usually the change in the compass direction. An important question is that of the seat of the forces regarded as causing the observed effects; whether it be above the earth's surface or below, or even of combined origin. Another fundamental question is, whether an actual change of magnetization in addition to a shift of the magnetic axis takes place, and if so its magnitude and duration. In the case of the very notable storm of October 31–November 1, 1903, it would appear as though an actual diminution of the earth's magnetic moment occurred which continued almost for two months after the apparent cessation of the storm. Similar calculations are in progress regarding the more recent storms.

Optical Properties of Electrolytic Films of Iron, Nickel and Cobalt: C. A. Skinner and A. Q. Tool, University of Nebraska.

An Absolute Gauge for Measuring High Hydrostatic Pressures: P. W. Bridgman, Harvard University.

The pressure range over which it has been hitherto possible to measure various physical effects of high pressure has been restricted by the fact that the common forms of pressure gauge leak at very high pressures. The best known work in this field has been that of Amagat, who worked to about 3,000 kgm. per sq. cm. This is the working pressure in modern high power artillery. The essential parts of all gauges for these high pressures are a piston fitting a cylinder so accurately that the friction between them is small and at the same time the leak past the piston is very slow. At high values of pressure the leak becomes so rapid that it is impossible to make measurements. In this paper a form of the usual gauge was described in which the cylinder is made to shrink automatically by the pressure, so that the leak remains slight even at very high pressures, while the freedom of motion of the piston is not impaired. With this gauge pressure measurements accurate to .1 per cent. have been made to nearly 7,000 kgm. per sq. cm. At higher pressures other parts of the apparatus break. This is not the limit of the gauge.

The Resistance of Mercury as a Secondary Gauge for High Pressures: P. W. Bridgman, Harvard University.

In practical use the above form of gauge is inconvenient because it is slow and unwieldy. In this second paper measurements of the electrical resistance of mercury under pressure are given from which the pressure may be calculated if the change of resistance is known. Electrical resistance is very easy to measure, and it is proposed that in practise pressure be measured in this indirect way. The accuracy attainable is .1 per cent. The total change of resistance for 7,000 kgm. is about 20 per cent. As one would expect, the change in the resistance effected by pressure is less when pressure is high, as is also the change brought about by temperature change. The change of resistance is about ten times the change of volume produced by a corresponding pressure.

Methods for Measuring Compressibilities at High Pressures: P. W. Bridgman, Harvard University.

In this paper methods were described for measuring the cubic compressibility of solids or of liquids at these high pressures. Measurements were made of several samples of steel, glass and aluminum. The values for steel fall between the two best previous determinations, which differ by 100 per cent. The other values agree with the commonly accepted results. The accuracy of the method is about .35 per cent., considerably higher than the best previous determinations. The only liquid measured was mercury. In only one instance has this been measured before to more than 500 kgm., when measurement was made to 3,000 kgm. The value found in this work agrees with former values, except that the change of

compressibility with pressure seems somewhat less than has been supposed.

An Experimental Determination of the Terminal Velocity of Fall of Small Spheres in Air: JOHN ZELENY and L. W. McKEEHAN, University of Minnesota.

Stokes's formula for terminal velocity of fall of a sphere in a viscous fluid expresses the result in terms of the acceleration of gravity, the radius of the sphere, the density of the sphere, the density of the fluid and its viscosity. This formula has been used by J. J. Thomson, H. A. Wilson and others in the determination of the charge carried by a gaseous ion.

The velocity of fall of lycopodium, which satisfies Stokes's criterion that the sphere shall be small, was determined experimentally. Variations in the size and density of individual particles were provided against by finding the time of fall, in a wide tube, of a large number of particles in each experiment. The time of fall of the center of gravity of the cloud of particles was assumed to be that of a single particle of average radius and density. The uniformity of the material makes this admissible.

The formula gives velocities, for this particular size, 50 per cent. in excess of those observed. Since this difference depends probably on the size employed, the amount by which the charge on an ion must be increased can not be stated until further experiments are carried out with particles of different sizes.

Note on the Effect of the Phase of Harmonics on Sound Waves: M. G. LLOYD and P. G. AGNEW, Bureau of Standards, Washington.

A harmonic alternator set giving frequencies from 60 to 900 was used to excite a telephone. By choosing a fundamental from one machine and a harmonic from another, and then driving the two generators just out of synchronism, a continuous cyclic change of phase relation occurs. Ordinarily the combined tone sounded by the telephone changes periodically, but these changes are really beats due to the interference of higher harmonics common to the two sources. By connecting the generators three phase, star, and choosing frequencies having a ratio of 3 to 1 or 9 to 1, common impurities are eliminated. When so connected no change in the sound could be detected at low intensities. With louder tones there were cyclic changes which were believed to be due to harmonics introduced by the telephone itself, rather than to an actual dependence of quality upon phase.

Magnetic Double Refraction Normal to the Field in Liquids: C. A. SKINNER, University of Nebraska.

Fourteen different liquids were investigated, including nitrobenzol, nitrotoluol, chlor-benzol, brom-benzol, etc. Twelve of them showed electric double refraction. Each was studied through the spectrum from blue to red (440 to 660). The two effects agree in the law of variation. In carbon bisulphide alone were the electric and the magnetic β of opposite sign.

The Absorption Spectra of Various Potassium and Uranyl Salts: HARRY C. JONES and W. W. STRONG, Johns Hopkins University.

The purpose of this investigation was to find out the nature of the absorbers of the light rays and the effects upon them of external conditions. It is possible in the case of the uranium atom or molecule to make a large number of changes that affect its absorbing power. Salts like the nitrate, sulphate, bromide, acetate and chloride of UO_2 have been used. This gives the effect of the chemical radical on the absorption. Different solvents can be used and various concentrations and the temperature varied. The solution can be placed under great pressure or in a powerful magnetic field. Dehydrating agents like aluminium chloride and sulphuric acid can be added. Some or all of these changes are being made and some interesting results have been found.

A Rowland concave grating is used to give the absorption spectra. Wratten and Wainwright red sensitive films are used for the photographic work. The work is being carried on by a grant from the Carnegie Institution of Washington and is a continuation of the work of Jones and Anderson (Publication No. 110, Carnegie Institution).

Beer's law was found to hold for potassium chromate, potassium dichromate, potassium ferrocyanide and potassium ferricyanide. Concentrated solutions of the uranyl salts do not obey Beer's law.

Uranyl salts show ten absorption bands in the blue-green part of the spectrum. When aluminium chloride is added to uranyl chloride these bands are shifted towards the red. Calcium chloride acts in the same way. Several new bands have been found for the chloride (these are very narrow) which none of the other uranyl salts have so far been found to show.

New Series in the Spectra of Ca, Sr and Ba: F. A. SAUNDERS, Syracuse University.

Photographs of the arc and spark spectra of Ca, Sr and Ba, taken with a quartz spectrograph, show several new ultra-violet lines. In Ca a new spectrum series was found, consisting of reversed single lines, beginning with λ 2398, eight lines in all being observed, five of them new. In Sr a similar series exists, seven lines having been observed. In Ba there are evidences of the same sort of thing. Series of *pairs* have been known for some time to exist in these spectra; few of the lines, however, having been picked up. Four new pairs were found in Ba and two in Sr, which help to fill out the two "subordinate" pair series in each of these elements. Formulæ which represent these series were calculated out, as was also done in the case of the series first mentioned.

Ionization in Closed Vessels: W. W. Strong, Johns Hopkins University.

The purpose of these experiments is to find what the nature of the external radiations are, that produce part of the ionization in closed vessels. In order to do this it is necessary to use a vessel in which the ionization produced by the walls of the vessel itself is constant. This ionization can be easily found by putting the vessel within a thick screen of metal or water so that all external radiations are absorbed.

Electroscopes were used for this work and the ionization of the enclosed gas was measured by means of the rate of leak of the electricity from the gold-leaves suspended inside the electroscope. The charged system inside the electroscope could be charged from the outside by means of a small spark gap. The electroscope was, therefore, air-tight and everything inside the vessel remained the same unless affected by radiations that could pass through the walls of the electroscope.

By letting the electroscope into a large cistern it was surrounded by a screen of water at least four feet thick. This was done with an electroscope September, 1907 (*Phys. Rev.*, p. 44, July, 1908). The same electroscope was placed in the same cistern, July, 1908. (Readings of the electroscope were here given.)

These readings show that the natural ionization within the vessel had remained practically constant throughout almost a year.

The same electroscope (and others in a like manner) when placed outside of buildings showed very marked increase in its rate of leak during the day. This, therefore, must be due to some external radiation that was screened off by the water in the cistern. (Screens of lead and iron were also used.) Care was taken to keep the temperature of the electroscope constant.

Velocity of the Negative Ions Produced by the Ultra-violet Rays in Various Gases at Different Pressures and Temperatures: Alois F. Kovářík, University of Minnesota.

The object of this investigation is the study of the structure of the negative ion. For this purpose the velocity is measured at different pressures and at different temperatures. The method used is that of an alternating field. In the case of air the product of the velocity by the pressure is nearly constant between the pressures 760 mm. and 200 mm., but at 100 mm. this product increases by 25 per cent., at 60 mm. by 65 per cent. and at 4.3 mm. by 200 per cent. above the value at 760 mm. In the case of CO_2 the product changes a little more rapidly. The velocity of the negative ions in dry air at 760 mm. and 0° C. is 2.05 cm. per second for a gradient of 1 volt per centimeter, and in dry CO_2 at ordinary conditions of pressure and temperature, the velocity is about 1.02 cm. per sec.

Preliminary experiments with change of temperature were made in air and up to 400° C. the velocity was found to vary inversely as the density of air. These experiments are being continued.

Momentum Effects in Electrical Discharge: F. E. Nipher, Washington University.

An electrical discharge is sent around a right angle in a wire. Spark discharge passes from machine to earth in either the positive or negative line.

A very marked difference between the positive and the negative discharge is found. A decided difference between the effects on the photographic plate is found on the two sides of the angle. The negative discharge is the active one in both lines. An account of these experimental results is given in Science for December 4, 1908. The actual effects were shown by means of a large number of lantern slides.

Electrical Stimulation of Plant Growth: Amos B. Plowman, Beaver, Pa.

Experiments and observations extending through a period of more than ten years, indicate rather conclusively that electrical charges of positive sign more or less completely inhibit the vital processes of plant protoplasm through which such charges are caused to pass; while, within a rather wide range of conditions, negative electrical charges stimulate such processes, sometimes to a quite remarkable degree.

Most of the striking results of electro-culture, including those recently obtained by Sir Oliver Lodge, are quite readily accounted for, if the above conclusions are correct.

This paper was illustrated by means of several photomicrographic and other lantern slides.

Note on the Kathode Equilibrium of the Weston Cell: F. A. WOLFF, Bureau of Standards, Washington.

The Theory of Coupled Circuits: LOUIS COHEN, Bureau of Standards, Washington.

It is a well known phenomenon that when two electrical circuits are coupled together either electromagnetically or direct, two distinct oscillations will be produced in either circuit, and there will also be two distinct damping factors. The problem was the subject of several important papers by several eminent German physicists, but there are certain mathematical difficulties inherent in the problem, which made it difficult to get the complete solution, and all previous investigators limited themselves to some form of approximation.

In this paper an entirely different method of mathematical treatment was adopted and which made it possible to obtain an exact solution. The paper being of a mathematical nature it is rather difficult to give an outline of the work in an abstract. The results are as follows: If we denote by V_1 and V_2 the potentials in the primary and secondary circuits, we have

$$V_1 = \{H_1 e^{-a_1 t} + H_2 e^{-a_2 t}\} \cos \lambda_1 t + \{H_3 e^{-a_1 t} + H_4 e^{-a_2 t}\} \cos \lambda_2 t,$$

$$V_2 = H_5 \{e^{-a_1 t} + e^{-a_2 t}\} \cos \lambda_1 t + H_6 \{e^{-a_1 t} + e^{-a_2 t}\} \cos \lambda_2 t,$$

a_1 and a_2 are the damping factors, λ_1 and λ_2 are the frequency constants and they have been completely determined.

Photographic Registration of Sounds: DAYTON C. MILLER, Case School of Applied Science, Cleveland.

For making large scale records, showing the details accurately, of complex sound waves having frequencies ranging from 500 to 10,000, the phonograph and oscillograph methods seem unsuitable. The following direct mechanical method has given satisfactory results.

A small steel cylinder, 1 mm. in diameter, is arranged to receive angular motion with a minimum of reaction effects, which is proportional to the displacement of a sensitive diaphragm. A minute mirror, with its plane in the axis of the cylinder, reflects light to a special camera, and at a distance of 30 cm. gives waves 15 cm. wide which show great detail. Long strips of photographic films were shown and projected by the lantern, showing with great clearness and in full detail the record of overtones, intensity variation, etc., of various spoken phrases. (The words "physical laboratory" received careful and interested attention from the audience.)

The Thermodynamics of Saturated Vapors: J. E. SIEBEL, Chicago, Ill. (Read by title.)

The object of this paper is to demonstrate the necessity of an investigation as to whether certain hypothetical concepts in the theories of thermodynamics and which find their most general expression in the assumption of a universal identical zero of energy (—273° Cels.) and a supposed universally irretrievable dissipation of energy are equally applicable to the thermodynamics of saturated vapors as they appear to be to the thermodynamics of permanent gases.

The Heat Balance in Thermoelectric Batteries: J. E. SIEBEL, Chicago, Ill. (Read by title.)

The author attempts to show that the heat and electricity exchanged in thermoelectric elements are functions of temperature, specific heat and conductivity and produces a formula and calculations made thereby, the results of which latter conform apparently well with a number of experimental results obtained by other observers.

The Effect of the Magnetic Impurities in the Copper Coils of Moving Coil Galvanometers upon their Sensitiveness, Hysteresis and Zero Shift: ANTHONY ZELENY, University of Minnesota.

The magnitude of the effect due to the magnetic impurities in the copper coils upon the sensitiveness of a moving coil galvanometer was determined by obtaining the period of vibration of the coil system in and out of a magnetic field.

If M represents the moment, per unit angle of displacement of the coil, due to the magnetic impurities; T, the torsional moment; and t_1 and t, the periods of vibration of the system when the coil is within and outside of the magnetic field; then

$$M/T = (t^2 - t_1^2)/t_1^2.$$

The value of the galvanometer constant is increased due to the magnetic impurities by the factor $(1 + M/T)$.

The values of M/T were determined for several galvanometer coils in fields of various strengths produced by an electromagnet. The values, when using a 1.5 mil phosphor-bronze strip for the upper suspension, varied for different coils from

0.82 to 1.31, in a field whose intensity was 400 units, which is the intensity usually found in ordinary galvanometer fields.

By plotting the relation between M/T and the field strength when the values of the latter were both increasing and decreasing, a marked hysteresis was found, which explain the hysteresis observed in galvanometer deflections whose magnitude depends somewhat on the direction from which the coil comes to its deflected position.

The relation between the strength of the magnetic field and the "set in the fiber" obtained after a reversed deflection was found to be proportional to the strength of the field, except that in weak fields there was no observable set. This shows, as previously explained by the writer, that the set is practically all due to a change in the strength and the direction of magnetization of the impurities in the coil. This magnetization gradually returning to its normal strength and direction explains also, in part at least, the shifting of the zero point with time.

The Three Temperature Coefficients of the Moving Coil Galvanometer and their Relation to the Temperature Coefficients of its Various Parts: ANTHONY ZELENY and O. HOVDA, University of Minnesota.

The values of the temperature coefficients for galvanometers having chilled cast-iron magnets are given in the following table, where B is the temperature coefficient of a particular circuit.

Measurement	Suspension	Coefficient
Current,	Phos. bronze,	$+0.00018$
	Steel,	$+0.00005$
Potential,	Phos. bronze,	$+0.00018-B$
	Steel,	$+0.00005-B$
Ballistic,	Phos. bronze,	-0.00017
	Steel,	-0.00017

The temperature coefficient for current measurements is shown to be

$$d_k' = F_k + t_k + L_k - D_k, \qquad (1)$$

where d_k', F_k, t_k, L_k, D_k, are the temperature coefficients respectively for deflections, field strength, period of vibration of the coil, and the linear expansion of cast iron and of copper.

The temperature coefficient for potential measurements can be calculated from

$$d_k'' = d_k' - B, \qquad (2)$$

where B, as given above, is the temperature coefficient for the resistance of a particular circuit.

The temperature coefficient for ballistic throws is

$$d_k = d_k' - t_k. \qquad (3)$$

These equations enable any one of the three temperature coefficients to be calculated from the known temperature coefficients of the various parts of the galvanometer.

The temperature coefficients of a galvanometer with a magnet other than chilled cast iron can be calculated from

$$K' = K + (F_k' + 0.00040), \qquad (4)$$

where K represents the value of any particular coefficient given in the above table, corresponding to the one desired, and F_k' is the temperature coefficient of the field strength for the magnet of the galvanometer whose temperature coefficient is to be determined.

A New Method for the Absolute Measurement of Resistance: E. B. ROSA, Bureau of Standards, Washington.

A Plea for Terrestrial and Cosmical Physics: L. A. BAUER, Carnegie Institution, Washington. This paper will be published in full in SCIENCE.

The Ellipticity of the Earth is Not a Proof of a Former Liquid State: JOHN F. HAYFORD, Coast and Geodetic Survey, Washington.

The idea is often expressed, even by physicists of high rank, that the observed ellipticity of the earth is a proof of a former liquid state. This idea is based upon a gross misconception of the magnitude of the stresses which would be produced within the earth by any departure of the actual ellipticity from the value corresponding to the rate of rotation. Sir George Darwin has computed that a departure of only one seventh part, of the actual ellipticity from that corresponding to the rotation, would produce stress-differences in the interior of the earth as great as five tons per square inch. Even the best granite will ordinarily fail under a stress-difference less than five tons per square inch. Therefore, unless the earth in its inner parts is stronger than the best granite it will yield to the stresses and take a new shape before the actual ellipticity has departed from that due to the rotation by as much as one seventh part.

Any one who will start from this as a basis and consider the improbability of the earth being as strong as the best granite throughout, even if it is solid, consider the improbability of the material in the earth being incompressible under stresses applied continuously for ages, and consider the uncertainty introduced into the evaluation of the theoretical ellipticity due to rotation on account of this evaluation being affected by the assumed relation of depth and

density, he will reach the conclusion that the present apparently close agreement between the observed ellipticity and the theoretical ellipticity due to rotation is not a proof of a former liquid state.

He will conclude that it is merely an indication of the strength of the material in the interior of the earth, and that the evidence is far from being sufficient to prove that the strength of the material in the interior, available to resist stress-differences, is now or ever has been so small as to justify the statement that the material is or has been a liquid.

Atomic Theories: L. T. MORE, University of Cincinnati.

An Electrical Method for Determining the Amount of Moisture in Grain and Other Materials:[1] ANTHONY ZELENY, University of Minnesota.

Two plates or pointed conductors made of dissimilar metals are inserted into the material in which it is desired to know the amount or percentage of moisture. These plates or points form the electrodes and the moisture the electrolyte of a voltaic battery which causes a current to flow through the galvanometer, whose magnitude depends on the amount of the moisture.

The size of the scale divisions representing any definite amount of moisture is first determined experimentally for each particular kind of material. When the temperature of the material under test influences the magnitude of the deflection, a proper galvanometer shunt is used with its lugs labeled in degrees, so that, when set to indicate the temperature of the material, the proper values for the amount of moisture are obtained regardless of the temperature.

In the case of corn, it was found desirable to have the two dissimilar metals of copper and zinc in the form of points which are pressed into the germ of the individual kernel. The deflection obtained indicates directly the percentage of moisture in the whole kernel. A curve exhibiting the relation between the deflection and the percentage of moisture was shown.

This apparatus is found to be capable of giving values accurate to about 0.1 per cent.

On the Extra Transmission of Electric Waves: F. C. BLAKE, Ohio State University.

With the same apparatus that Blake and Fountain (*Phys. Rev.*, XXIII., p. 257, 1906) used, the conditions insisted upon by Dr. Schaefer (*Phys. Rev.*, XXIV., p. 421, 1907) were fulfilled. Two diaphragms, 2.5 meters square and of aperture 24 by 32 cm., were inserted, one near the vibrator mirror, the other near the receiver mirror with the resonator system between them. Nine per cent. of *extra transmission* was found, using long strips 3 cm. apart on plate glass. Afterward only a single diaphragm was used, it being placed as near as possible to the receiver mirror. Its aperture was 68.5 cm. long and of a width that was varied from 8 to 61 cm. The *extra transmission* was 15 per cent. in amount and independent of the width of the diaphragm aperture.

Taking this last value as a true measure of the extra transmission it would appear that the use of diaphragms, especially when their apertures are as small as Schaefer demands, introduces errors due to diffraction, but in no case does it completely mask the effect of extra transmission.

Then the vibrator was varied by short steps a distance of 1 cm. either way from its usual focal position of 7.5 cm., a single diaphragm of aperture 68.5 by 16 cm. being used near the receiver mirror. No change in the extra transmission was obtained, although these vibrator changes changed the beam from one quite strongly divergent to a convergent beam.

Entladungsstrahlen: ELIZABETH R. LAIRD, Mount Holyoke College.

A Spectrometer for Electromagnetic Radiation: A. D. COLE, Ohio State University.

The continuation of work on diffraction of electric waves, on which a partial report was given at the New York meeting of the American Association for the Advancement of Science, made it desirable to have a more convenient means of quickly changing the angle between the direction of wave propagation and the line connecting the diffraction edge or slit with the receiver. This resulted in a mounting for the several parts of the apparatus similar to that of the parts of a working spectrometer for light radiation.

It seemed worth while to develop the design still farther, so that the apparatus might later be used by advanced students as a more convenient means of repeating the classical experiments of Hertz, Boltzmann and Righi. The use of the conventional spectrometer design serves to strengthen the force of the analogy between electrical and light radiation, particularly when used for lecture demonstrations, for which it is well adapted. Drawings of the apparatus with a considerable variety of accessories for special uses, were shown and described. By a few simple

[1] Patent pending.

changes and adjustments it is easily and quickly adapted for use as an optical bench or as an interferometer for electromagnetic radiation. The wave-lengths preferred are from 10 to 15 cm., the parabolic mirrors of 35 cm. aperture, lenses and prism 22 cm. high, prism-table 26 cm. diameter, and the length over all 225 cm. It is made of oak, and provided with four graduated circles for reading the angles through which different parts of the apparatus are rotated when in use.

A Method of Determining the Electrode Potentials of the Alkali Metals: GILBERT N. LEWIS and CHARLES A. KRAUS, Massachusetts Institute of Technology.

The electrode potentials of the metals of the alkalies and the alkaline earths, notwithstanding their great importance, have never been determined, because of the extreme reactivity of these metals. The method now adopted, which has proved entirely successful in the case of the sodium electrode, consists in measuring the electromotive force between the metal and its dilute amalgam in mercury, with an electrolyte consisting of a solution of a salt of the metal in liquid ethyl amine. The electromotive force so obtained can readily be shown to be independent of the electrolyte and the solvent. It is, therefore, the same as would be obtained if the electromotive force between the metal and amalgam could be measured in an aqueous solution. The potential of the amalgam, against a normal aqueous solution of a salt of the metal may with certain precautions be measured directly against a normal electrode. Adding the electromotive force so obtained to the electromotive force between the metal and amalgam gives directly the potential of the metal in a normal solution of its ion in water (potential of the normal electrode taken as zero). In the case of sodium, this method has made it possible to determine the electrode potential within a few tenths of a millivolt. The value obtained is about half a volt higher than that which has been previously assumed for the sodium electrode.

Non-Newtonian Mechanics and the Principle of Relativity: GILBERT N. LEWIS and RICHARD C. TOLMAN, Massachusetts Institute of Technology.

The laws of non-Newtonian mechanics previously derived by one of the authors from the fundamental conservation laws and from a simple assumption in regard to the nature of light are identical with those which Einstein has obtained from the principle of relativity and the laws of electro-dynamics. In this paper it is shown that the same equations may be obtained without the aid of the electro-magnetic theory from the principle of relativity and the conservation laws.

On the Influence of Temperature and Transverse Magnetization upon the Resistance of Bismuth and Nickel: F. C. BLAKE, Ohio State University.

The resistance of nickel and bismuth was investigated over a range of temperature from — 192° C. to + 183° C., and for all field-strengths between 0 and 36.6 kilogauss. For measuring temperature flat spirals of fine platinum wire were attached to the mica supports of the bismuth and nickel spirals. The apparatus was that previously used by duBois and Wills (*Verh. d. D. Phys. Ges.*, I., p. 169, 1899).

At liquid air temperatures no such high values of the resistance of bismuth were obtained as had been obtained by Dewar and Fleming and by duBois and Wills. Instead, a maximum of resistance was found between — 160° and — 180° C. for fields greater than 30 kilogauss. The higher the field the higher the temperature at which this maximum appeared.

If R' is the resistance in the field H at the temperature T, and R_0 the resistance without the field at 0° C., then $R'/R_0 = f(T, H)$. A set of isothermal curves, $R'/R_0 = f(H)$ and another set of isopedal curves, $R'/R_0 = f(T)$ were experimentally determined.

For nickel a set of isothermal curves, $(R' - R)/R_0 = f(H)$, where R is the resistance of the nickel out of the field at temperature T. For all temperatures investigated the fraction $(R' - R)/R_0$ was negative for fields greater than 2,500 gauss, and its value was greater for the higher temperatures. For fields greater than 10 kilogauss it increased with increasing field except at liquid air temperatures; at — 190° C. it was a maximum at 8 kilogauss, decreasing slowly for higher fields. For fields less than 2,500 gauss this fraction was positive and it was thought that part or all of this increase in resistance for low fields could be explained by longitudinal magnetization, whose presence could not be wholly avoided.

A New Form of Standard Resistance: EDWARD B. ROSA, Bureau of Standards, Washington.

The new form of resistance standard, which has been developed at the Bureau of Standards during the past two years, differs from the Reichsanstalt form in being smaller and having the resistance coil sealed air tight in a case that is filled with pure oil, insuring protection for the resistance

coil from the effects of atmospheric moisture, reduces the danger of oxidation due to imperfect covering of shellac, and protects the coil from mechanical injury. The resistances when properly prepared and mounted and protected in this manner, remain remarkably constant in value, whereas open coils in oil almost invariably have a higher resistance in summer than in winter, and fluctuate more or less in value from time to time with the weather. As a result of the discovery of the effect of atmospheric humidity on the resistance of standards made at the Bureau of Standards, the National Physical Laboratory of England has sealed its standards, and the German Reichsanstalt is keeping its standards in a chamber at a constant humidity. The use of the new sealed resistances at the Bureau of Standards has increased the accuracy of resistance work appreciably.

A Proposed Modification of the Kirchhoff Method for the Absolute Measurement of Resistance: FRANK WENNER, Bureau of Standards, Washington.

An Instrument Designed for More Precise Determination of Magnetic Declination at Sea: WILLIAM J. PETERS, Department Terrestrial Magnetism, Washington.

The cruises of the *Galilee* in the Pacific Ocean, among other results, made very apparent the necessity of more accurate determinations of magnetic declination than could be made with the ordinary instruments of navigation. A collimating instrument has been constructed by Mr. A. Widmer, mechanician of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, which will be used in experimental work on the vessels now being built for a magnetic survey of the ocean areas. Experiments were made on the last cruise of the *Galilee* which assured the practicability of using such an instrument and indicated the possibility of a high order of accuracy.

Many parts of the Ritchie ten-inch liquid compass were used. The card was altered to a four direction collimator by the addition of four concave mirrors with a scale of seven divisions in the focus of each. This alteration increased the original mass by one twentieth part, but decreased the radius of gyration. The period of the collimator arrangement in liquid is now about eleven seconds at Washington. The angle between a collimator axis and a celestial body is measured by a pocket sextant, the scale being viewed through windows in the bowl. The instrument is not intended for a navigation instrument, but as a step in the attainment of the highest precision in determinations of magnetic elements at sea.

(The paper will be printed in full in the March number of *Terrestrial Magnetism and Atmospheric Electricity.*)

The Electrical Conductivity of the Atmosphere Over the Pacific Ocean: PAUL H. DIKE, Carnegie Institution, Washington.

The work described was done on board the Magnetic Survey Yacht *Galilee* during the cruise of 1907–08. The purpose was to obtain data as to the earth-air current at sea, to compare with similar results obtained on land. The method involves the measurement of two quantities, the specific conductivity of the air and the vertical potential gradient. The latter measurement was found to be impracticable on board ship, and only a few values were obtained, during a calm. These were of the same order of magnitude as are ordinarily observed on land. The specific conductivity of the air was measured by means of the Gerdien apparatus, consisting of a cylindrical condenser, the inner cylinder of which is connected with an electroscope. The conductivity of the air is computed from the rate of dispersion of a charge put upon the inner cylinder when a uniform current of air is drawn through the apparatus. The reading of the electroscope offered the principal difficulty.

The mean values of the conductivity from all the observations of the voyage were as follows:

$$\lambda_p = 1.603 \times 10^{-4} \text{ electrostatic units.}$$
$$\lambda_n = 1.433 \times 10^{-4} \quad \text{"} \quad \text{"}$$
$$\lambda_p/\lambda_n = 1.12$$

Assuming a potential gradient of 100 volts-meter these values of conductivity give a vertical earth-air current 3×10^{-16} amperes per square centimeter of the earth's surface, slightly larger than the usual value on land. No variation with latitude was discernible, though the observations extended from 65° 41′ north to 45° 07′ south.

Ultra-violet Absorption and Fluorescence and the Complete Balmer Series of Sodium Vapor: R. W. WOOD, Johns Hopkins University.

The absorption spectrum of dense sodium vapor, contained in a steel tube one meter in length, provided with quartz windows and heated red hot in a combustion furnace, shows the lines of the principal series (Balmer formula) reversed. But seven lines of this series have been previously observed, the observations having been confined to the emission spectrum.

Employing a small quartz spectrograph by Fuess (focus 15 cm.) 24 lines were found and measured and indications of the "head" of the series appeared in the plate though it was not resolved into lines.

With the large quartz spectrograph of the Bureau of Standards 48 lines were resolved, bringing us within 0.1 of an Angstrom unit of the theoretical head of the band. The largest number of lines forming a Balmer series ever observed in the laboratory is twelve in the case of hydrogen (Cornu and Ames). Solar hydrogen (chromosphere) shows 29 lines. The sodium series is 19 ahead of any Balmer series ever observed, even in celestial sources. These ultra-violet lines are accompanied on each side by a channelled spectrum, analogous to the channelled spectra observed in the vicinity of the D lines, which form the first member of the Balmer series.

It is in the region of the channelled spectra that the interesting results in the fluorescence of the vapor previously described were found. An attempt was accordingly made to ascertain if the ultra-violet channelled spectra exhibited the same phenomena. Such was found to be the case. Exciting the vapor with the zinc spark, a strong fluorescence was found to be stimulated by the zinc triplet at 3344–3302.

Results of Some Recent Intercomparisons of Magnetic Standards by the Carnegie Institution of Washington: J. A. Fleming, Carnegie Institution, Washington.

One important detail of the magnetic survey of the globe undertaken by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington is that of the correlation of the observatory standards of various governments and institutions. Comparisons have already been made at seventeen observatories in various parts of the world; the results of the four most recent intercomparisons were discussed in detail in the paper and may be summarized thus: The following corrections should be applied to the provisional standards of the Department of Terrestrial Magnetism of the Carnegie Institution. The probable errors of mean differences are given with them. For Kew Observatory; declination $+0'.6 \pm 0'.15$, horizontal intensity $-0.0001H \pm .00005H$, inclination $-2'.6 \pm 0'.1$. For Helwan; dec. $+0'.5 \pm 0'.1$, hor. intens. $+0.0004H \pm .00004H$, inclin. $+0'.1 \pm 0'.1$. For Tiflis; dec. $+0'.7$, hor. inten. $+.0006H \pm 0.00006H$, inclin. $-1'.7 \pm 0'.1$. For Christchurch; dec. $+1'.5 \pm 0.04$, hor. inten. $+0.0006H \pm .00006H$, inclin. $-1'.2 \pm 0.3$.

The values are to be applied algebraically, east declinations, north inclinations and horizontal intensities being considered positive, and west declinations and south inclinations, negative. The preliminary "International Magnetic Standard" for horizontal intensity is confirmed in view of the accordance of the correction at Kew with the indications of Watson's determinations of the earth's field in international units.

A Critical Review of the Problem of Pressure in the Kinetic Theory of Gases: Luigi d'Auria, Philadelphia, Pa.

This paper seeks to show that the recognized method of solution of this problem is erroneous and the gaseous pressure per unit area is equal to the energy of agitation of the gas per unit volume. It will be printed in *Popular Astronomy*.

The Dynamophone: J. Burkett Webb, Stevens Institute of Technology.

Some years ago the problem arose of measuring the power which a turbine transmitted through its shaft to the propeller. The ordinary "indicator" being useless, a method depending on the torsion of the shaft was invented. As it was the intention to protect it by patent, it could not be published sooner, but it has leaked out somewhat and more or less incorrect references to it have appeared in German papers.

The first idea was to measure the torque optically, but a better method was adopted. The apparatus necessitates no mechanical contact with the shaft and the speed can also be observed without the usual speed counter. The degree of accuracy is very high, there being no difficulty in making single observations within one per cent. of error.

The apparatus consists of two toothed iron rings which are fixed permanently to the flanges of the shaft at as great a distance apart as possible. Opposite these rings on a frame fast to the floor are mounted telephone magnets adjustable radially and concentrically as to the shaft axis. Each ring and magnet (or pair of magnets) constitutes an alternating dynamo whose current intensity can be regulated by the radial adjustment of its magnet and whose phase can be varied by the concentric movement, and these two dynamos are connected in series so that when the shaft is not twisted their phases are opposite and neutralize each other in a receiver inserted in the circuit. When, however, the shaft twists the phases become different and a clear tone is perceived.

To measure the torque one of the concentric adjustments is then made until the tone disappears and the angular change read on a scale graduated preferably to horsepower per revolution. The pitch of the tone compared with a calibrated tuning fork gives the speed. The necessary calibration of the shaft is made before it is placed in position or it can be made afterward. (A model was shown.)

Some Optical Effects of Changes in Ether Density: CHARLES F. BRUSH, Cleveland, Ohio. (Read by title.)

The Lumeter, a Practical Measure of General Luminosity: HENRY E. WETHERILL, M.D., Philadelphia. (Read by title.)

A Ballistic Dynamometer Method of Measuring Hysteresis Loss in Iron: MARTIN E. RICE and BURTON McCOLLUM, University of Kansas. (Read by title.)

The sample to be tested, which should be laminated, is wound with a primary coil and a test coil. The latter is connected in series with the fine wire movable coil of a dynamometer and the former in a series with the coarse wire-fixed coil of the dynamometer. When the primary current is reversed, the dynamometer measures by its ballistic deflection the total energy loss per half cycle in the iron and in the test coil circuit. Since the hysteresis loss is independent of the period of the cycle while all the other losses measured are inversely proportional to the period of the cycle, it is easily possible by the insertion of a choke coil in the primary circuit and the use of a moderately high resistance test coil circuit to keep these other losses below one per cent. of the total loss measured. A comparatively rough estimate of these other losses is then sufficient to enable the true hysteresis loss to be determined with an error of only a small fraction of one per cent.

The dynamometer can be calibrated by discharging a condenser or a mutual inductance through its movable coil while a constant current is maintained in its fixed coil.

This method eliminates the difficulties inherent in the wattmeter methods due to uncertainties in frequency and wave shape while it avoids the tedious process of taking a long series of readings, plotting a curve and measuring its area, as in the ballistic galvanometer methods. Tests can be made much more rapidly than by the wattmeter methods, while the results obtained are fully as accurate as by the ballistic galvanometer methods.

On the Diurnal Variations in the Intensity of the Penetrating Radiation Present at the Surface of the Earth: G. A. CLINE, Toronto University.

On the Character of the Radiation from Potassium: J. C. McLENNAN, Toronto University.

The Action of Electrolytes on Copper Colloidal Solution: E. F. BURTON, Toronto University.

The experiments detailed in the present communication are a continuation of those performed by the writer on the action of small traces of electrolytes on silver and gold colloidal solutions prepared by Bredig's method. With these solutions the particles in the pure solution are negatively charged and it was found that, if an electrolyte was added, the positively charged ion was the potent one in reducing the velocity with which the particle moved in a given electric field; *i. e.*, the ion charged oppositely to the colloidal particle produces the discharge of the particle and consequently coagulation of the colloid.

Copper colloidal solutions were chosen on which to work because they have positively charged particles in the pure solution. The electrolytes used were solutions of potassium chloride, potassium sulphate, aluminium sulphate, potassium phosphate, potassium ferricyanide. With this series it was possible to compare the effect of the monovalent and the trivalent ions of both acids and bases.

Every electrolyte added produced a decrease of the velocity with which the copper particles moved to the cathode. It is the ion bearing the negative charge which is active in reducing the velocity. This power of the negative ion depends on the valency in a way analogous to the relations found by Picton and Linder, and Hardy for the coagulative power of ions. Evidence is also produced to show that the discharging power of two negative ions of the same valency is the same. Current observations on the coagulation of the colloids in each case showed that the particles coagulate more and more freely as the charge gets smaller and smaller.

Arc and Spark Phenomena in the Secondary of a High Potential Transformer: E. S. JOHONNOTT, Rose Polytechnic Institute. (Read by title.)

The Upper Inversion in the Atmosphere: W. J. HUMPHREYS, Mt. Weather Observatory, Md.

We have been accustomed to think of the atmosphere as growing steadily colder to nearly or quite absolute zero with increase in elevation, but hundreds of records obtained in many parts of the world by the aid of free balloons show that this assumption is very wide of the truth.

These records tell us, among other things:

(a) That through the first ten thousand feet next the earth the temperature changes irregularly, and often has one or more layers warmer than the regions immediately below or above them.

(b) That roughly between ten thousand and forty thousand feet above the surface of the earth the temperature falls tolerably regularly, approximately at the rate of 0°.7 C. per hundred meters, or 0°.4 F. per hundred feet.

(c) That somewhere in the neighborhood of forty thousand feet elevation the temperature quits falling, usually abruptly, and commonly increases slowly from this level up to the greatest elevation yet reached, about 26.6 kilometers (16½ miles).

The place where the temperature quits falling and begins to rise is called the inversion level. Its elevation and its temperature both change with seasons, with latitude, and with storm conditions.

This inversion and all the other phenomena connected with the temperature gradients of the atmosphere appear to be satisfactorily accounted for by the known composition of the atmosphere and the laws of radiation and absorption.

The paper in full appears in the *Astrophysical Journal*, January, 1909.

Some Results in Solar Magnetism: W. J. HUMPHREYS, Mt. Weather Observatory, Md.

The splendid work of Hale and others at Mount Wilson has led to the conclusions: (a) that sun spots are cooler than the surrounding regions; (b) that they are centers of violent cyclones; (c) that they are accompanied by magnetic fields of great intensity.

Assuming the effective temperature of the sun to be 6,000° C., simple convection can reduce the temperature of solar vapor to about 5,000° C., so that lower temperatures, if such exist, must be due to some such explosive action as Fox has shewn to accompany the spots.

The observed tangential velocity of 100 kilometers per second can not be accounted for as the result of simple differences in barometric gradients.

The observed magnetic field can not be due to a whirling surface charge, since a charge sufficient to produce it would cause disruptive radial forces. A volume charge, however, of the negative sign, analogous to that which somehow exists in the earth's atmosphere might lead to the observed effects.

The magnetic fields of the sun spots, however produced, can not extend in measurable amounts to the earth, and therefore our magnetic storms are still without a definitely assignable cause.

The full paper appears in *Terrestrial Magnetism and Atmospheric Electricity*, December, 1908.

Note on Thermoluminescence: ELIZABETH R. LAIRD, Mt. Holyoke College.

Theory suggests that the change producing luminescence goes on very slowly at ordinary temperatures in thermoluminescent salts and is merely accelerated by raising the temperature. An additive method of obtaining the effect of thermoluminescence should therefore show its existence at room temperatures.

This was tested by wrapping up photographic plates for different periods of time with sensitive film toward a thermoluminescent salt and developing later, at the same time heating the salt to observe the remaining effect.

The salts used were solid salt solution of calcium sulphate and magnesium sulphate, the same with an undetermined admixture and calcium sulphide which had been kept in the dark some time after all visible luminescence had ceased.

The results showed that the photographic plate was unaffected in each case, with exposures varying from two weeks to two months, according to the salt used and the amount of its previous exposure to light. Where the effect was uneven the greater effect corresponded to the portions showing brighter thermoluminescence. Control plates used with salt that had not been exposed to light after heating showed no effect in the same time.

These experiments indicate that there is a slow change in thermoluminescent salts, probably similar to that occurring at a higher temperature.

ALFRED D. COLE,
Secretary

THE AMERICAN PHYSIOLOGICAL SOCIETY

THE American Physiological Society met in the physiological laboratory of the Johns Hopkins University, December 28 to 31. Sessions for the reading of papers were held in the forenoons of December 29, 30, 31 and the afternoon of December 31. Demonstrations were given in the afternoon. Seventy papers and demonstrations were presented.

A joint session with the American Society of Biological Chemists was held December 29. On the afternoon of the twenty-ninth the society met with Section K to hear the address of the retiring

vice-president (Dr. L. Hektoen) and for a symposium upon the subject of "The Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene." On the afternoon of the thirtieth there was a combined meeting with Section K, the Society of American Bacteriologists and the American Society of Biochemists. The following general papers were read and discussed:

"Anaphylaxis," by M. J. Rosenau.

"The Physiological Significance of Creatin and Creatinin," by L. B. Mendel.

"The Cause and Diagnostic Value of the Venous Pulse," by A. W. Hewlett.

The meeting was the largest in the history of the society, more than 80 members being present.

The following were elected to membership: T. G. Brodie, of Toronto; W. W. Hale, of Washington; W. A. Hewlett, of Ann Arbor; A. D. Hirschfelder, of Baltimore; A. Hunter, of Ithaca, N. Y.; D. R. Joseph, of New York; W. J. Meek, of Madison, Wis.; F. R. Miller, of Toronto; F. H. Scott, of Minneapolis; S. Simpson, of Ithaca; C. Voegtlin, of Baltimore.

The following officers were elected:

President—W. H. Howell.

Secretary—R. Hunt.

Treasurer—W. B. Cannon.

Additional Members of Council—A. J. Carlson, W. P. Lombard.

REID HUNT,
Secretary

THE AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

THE twenty-first annual meeting of the American Association of Economic Entomologists was held at the Eastern Female High School, Baltimore, Md., December 28 and 29, 1908. The annual address of the president was presented by Dr. S. A. Forbes, on "Aspects of Progress in Economic Entomology." A full program of interesting papers was presented at each session. A general discussion of the subject "Do we Need the Insectary?" was participated in by many of the members and many important facts were brought out in connection with the use of this important accessory to entomological work.

The report of the secretary showed that the association was making a healthy growth and that it was in a good financial condition.

A considerable amount of important business was transacted at the meeting which included a revision of the constitution, the adoption of a resolution defining the attitude of the association concerning the proposed affiliation of societies interested in agricultural science and the adoption of memorial resolutions on the deaths of Dr. William H. Ashmead, Alexander Craw, Dr. James Fletcher, Professor W. G. Johnson and Professor F. H. Snow, members who had died during the past year.

A long list of uniform common names of insects were adopted on recommendation of the committee on nomenclature.

Thirty-nine new members were elected.

The following officers were elected:

President—Dr. W. E. Britton, New Haven, Conn.

First Vice-president—Dr. E. D. Ball, Logan, Utah.

Second Vice-president—Professor H. E. Summers, Ames, Iowa.

Secretary—Mr. A. F. Burgess, Washington, D. C.

Member of the Committee on Nomenclature—Professor Herbert Osborn, Columbus, Ohio.

Members of the Advisory Board of the Journal of Economic Entomology—Professor Wilmon Newell, Baton Rouge, La., Dr. H. T. Fernald, Amherst, Mass., and Professor Herbert Osborn, Columbus, Ohio.

Members of the Council of the American Association for the Advancement of Science—Dr. S. A Forbes, Urbana, Ill., and Professor H. E. Summers, Ames, Iowa.

The attendance was the largest of any meeting in the history of the association, over a hundred being present at every session.

A. F. BURGESS,
Secretary

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES
SECTION OF BIOLOGY

THE regular meeting of the section held at the American Museum on January 11, 1909, was devoted to an illustrated lecture by Professor E. B. Poulton, of Oxford University, on "Mimicry among North American Butterflies." The lecturer was introduced by Mr. Charles F. Cox, president of the New York Academy, who made some brief remarks on selection and mimicry.

Prior to the scientific program a letter was read from Mr. W. K. Gregory, regretfully declining the election to the secretaryship of the section for 1909. Dr. L. Hussakof was then nominated and elected to the office for the same term.

A REGULAR meeting of the section was held at the American Museum, on February 8, 1909, Mr. Frank M. Chapman, chairman of the section, presiding. The following papers were read:

A New Example of Determinate Evolution: Professor BASHFORD DEAN.

In a previous paper the speaker had shown that the egg-capsule of the chimæroids at the time of deposition is adapted with singular precision to the needs of the future embryo, and had given reasons for the view that this adaptation was orthogenetic rather than selectional, in a legitimate sense. It was now shown that the egg-capsules of various chimæroids could be arranged in an orthogenetic series. In this series the head-and-body portion of the capsule becomes progressively shorter, the tail portion more slender, the lateral web disappears, the opening valve increases in length, the serrulæ of this valve reduce to a smaller area, and the respiratory pores of the tail end of the capsule to a longer one. This progressive series is accentuated by the recent discovery of an undetermined capsule from the North Atlantic (? *C.* (*Bathyalopex*) *mirabilis*) received by the speaker from Professor Jungersen, of Copenhagen.

Some Interesting Reptiles: Mr. RAYMOND L. DITMARS.

The speaker exhibited a series of living lizards and serpents illustrating the salient features in the evolution and classification of these groups.

The serpents are undoubtedly derived from lizards. Some of the latter possess grooved teeth and a series may be arranged among them showing the progressive decline in morphological and functional importance of the limbs. This series begins with such a form as the dragon lizard (*Basiliscus*) with long hind limbs and which, in running, carries its body clear above ground. In other forms the limbs are not so well developed, so that the body rests entirely on the ground (*Heloderma*) or may even be dragged (*Cyclodes*). A connecting link between serpents and lizards was exhibited (*Ophisaurus*). This form looks exactly like a snake, but is a true lizard.

In the serpents there are no traces of external limbs, though with the boas and pythons internal ones are present. The jaw is greatly distensible, and true grooved or caniculated fangs are developed among many. A number of interesting points in the habits of the serpents were brought out.

Field Observations on the Fin Whales of the North Pacific: Mr. ROY C. ANDREWS.

Mr. Andrews gave an account, illustrated by lantern slides, of his experiences while at the whaling stations on the coast of Vancouver Island and southern Alaska. The paper was devoted to a discussion of the habits of some members of the family Balænopteridæ and of the modern methods employed in their capture. Many reproductions of photographs were shown on the screen illustrating the manner of spouting, diving and feeding of these whales. The speaker dwelt especially upon the peculiar manner in which the nasal region is protruded during respiration, and upon the attitudes assumed by the animals when diving. The method of feeding and the movements during play were also discussed.

L. HUSSAKOF,
Secretary

AMERICAN MUSEUM OF NATURAL HISTORY

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

AT the 429th regular meeting of the society, February 16, 1909, Mr. Robert Grosvenor Valentine, the Assistant Commissioner of Indian Affairs, delivered an address on "The Unspoiled Indian," illustrating his remarks by the specific instance of the San Carlos Apache. The speaker said that the Indian had suffered less on account of that of which he had been despoiled than from the benefits which had been unwisely conferred upon him. He declared that he must be educated through his home, and therefore it is better to locate schools in Indian neighborhoods rather than remove the Indians from their homes and educate them apart as was the older government policy. In opening lands next to Indian reservations for settlement he believed it was important that the right kind of white men be induced to locate there. He favored opening such lands block by block to companies of settlers who had previously been neighbors rather than the present plan of throwing open all at once and bringing on a spectacular rush from all quarters.

The address provoked a lively discussion participated in by Dr. Merriam, Dr. McGee, Dr. Hough and the speaker, after which the president exhibited some blankets, belts and other articles made by the Apache and Navaho, and Dr. Merriam showed several pendants worked by California Indians out of feathers of the red flicker.

JOHN R. SWANTON,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, MARCH 26, 1909

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE REGULATION OF PHYSICAL INSTRUCTION IN SCHOOLS AND COLLEGES FROM THE STANDPOINT OF HYGIENE[1]

THE researches of modern physiologists on the growth of the brain and nervous system have done more to place the physical instruction of the young on a sound and logical basis than any other influence that can be named, for the specialization of the child's muscular system progresses with the increasing complexity of the brain, and the evolution of his physical nature is but an epitome of the evolution of the whole race.

The infant is born with but two definite voluntary movements, sucking and grasping, necessary for self preservation; all others consist of aimless waving and kicking of the arms and legs and it is not until the assumption of the upright position that the specialization begins that advances him above his four-footed fellows.

Relieved of their function of support, the arms rapidly learn movements of throwing and striking, grasping and pulling, and he familiarizes himself quickly with his surroundings and soon begins the imitation of the movements in animals and people and machines that are within his range of observation.

[1] An address delivered in a symposium on "The Regulation of Physical Instruction in Schools and Colleges, from the Standpoint of Hygiene" before Section K (Physiology and Experimental Medicine) of the American Association for the Advancement of Science, Baltimore, December 30, 1908.

This goes on with increasing freedom. He learns to handle hammers; to cut with a knife; to throw and catch and strike; to explore and hunt; to run and climb.

At the age of twelve the second great change takes place in his evolution. He finds that he is part of a community and begins to take interest in games involving organization. He becomes one of a gang or team, and this involves cooperation, self-sacrifice and discipline—qualities that he does not recognize before this stage.

A band of savages who have organized to fight under a chief instead of every man by his own hand have arrived at the same stage of evolution as Anglo-Saxon boys of twelve to fourteen, as has been so well pointed out by Gulick.

A rational system of physical instruction must follow this evolution if it is to be hygienic or successful, and this was done with preeminent success by Froebel in the kindergarten, where the games and exercises are designed to imitate the hopping of birds, the flying of bees, the circling arms of the wind-mill—objects familiar to the child and appealing to his awakening imagination.

With his increasing age the child is promoted to the lower grades of the public school where space becomes valuable and his freedom is curtailed by the limitations of the school room. The normal occupation of a child is play, but school life means periods of fixed posture and the first application of the hand of discipline to prepare him for community life.

Corrective exercises to overcome the evil tendencies of prolonged sitting when writing and reading must now be introduced, and the time for free play is curtailed.

The well-rounded course would contain these corrective exercises given at frequent intervals throughout the day; class exercises and marching for discipline; and the plays and games that children of that age have always played, modified in some cases to fit the limitations of time and space imposed by the school hours and the play ground.

At about sixteen there is a break in the youth's education. Most children finish their formal studies and go into their life's work. A few go on to college; but the freshman class of a college is also made up of young men recruited from the farm, the shop, the office, the factory and the night school, presenting all the mental and moral defects of these widely varying occupations. Many of them have uncorrected eye defects; round or crooked backs; narrow, flat chests and flabby muscles. The play instinct may have been crushed out by the hard grinding life of the factory, or office, and they may have lost the knowledge and desire to play. They are old before their time. In contrast to those are the undisciplined and self-sufficient athletic men, who do not take kindly to the discipline of college life, considering it as an unnecessary evil to be avoided as much as possible.

A careful physical examination should precede any attempt to provide physical instruction for college students.

This examination should include data on family history; habits of life; health history, obtained by leading questions which may be followed up if necessary; tests of simple maximum effort in the movements most frequently employed, extension of the back and legs, flexion and extension of the arms, the grasping power and lung capacity, with a certain number of measurements for purposes of comparison.

The students may then be divided into three classes: (1) Defective, (2) average and (3) athletes.

Defectives need personal advice and individual prescription to correct flat foot, uneven shoulders, constipation, hernia,

obesity, old heart lesions or joint injuries. These are given on cards and the student taken over each exercise in detail by an instructor who reports at frequent intervals.

The average man may be taken in classes which should begin by exercises of discipline, marching and setting-up movements to word of command. They should then be examined to find their ability to perform certain exercises of skill, and classified according to their proficiency. A course of graded exercises should follow, closing with a re-examination. This procedure may be repeated three or four times during the college year.

In designing the exercise to be given to the college student, the evolution of the race must be kept in mind and the old co-ordinations that have been responsible for its development must be used as much as possible in a natural manner.

1. *Locomotion:* in marching, running, jumping, dancing, tumbling, climbing and swimming.

2. Throwing large and small balls for distance and accuracy. Catching and dodging.

3. *Fighting:* by striking, as in boxing; by grappling, as in wrestling; by thrusting, as in fencing; and by striking, as in single stick or saber.

Some of these are best taught indoors, but where it is possible all exercises should be taken in the open air.

All the most popular athletic contests can be arranged to apply to the general mass of the students by setting a low standard, by having the whole class try a feat at once, by doing the exercise to word of command, and by stopping short of great fatigue.

After a certain time there is a tendency to specialize in those who find the general class work too easy, and this may be found on entrance to college in some whose preliminary training has been obtained in preparatory schools. They naturally drift into competitive athletics, but this involves an entirely different kind of training from that already described.

The distinction between physical training and athletic training must be sharply defined.

In physical training the object is to bring the standard of health up to its highest level, and all excessive strain or exhaustion is avoided while all the activities are exercised.

In athletic training the object is to bring the human machine to its highest point of efficiency to perform a definite feat, and everything that is useless or detrimental is sacrificed. The heart is made larger and stronger than is necessary for ordinary life if the feat to be performed is one of endurance. The nervous system is made irritable and alert if speed is required, the special muscles are developed, and the normal store of fat is lessened if agility is the necessary requirement. The object is not primarily health but superlative ability, either in strength, speed or endurance, and the undue absorption of fat leaves the constitution less able to withstand the siege of a constitutional infection like typhoid fever or pneumonia in which a moderate amount of fat is a valuable asset.

In deciding the value or harmfulness of athletic training, however, the physiologist has not always the last word to say. The ethical and social sides assume here an importance that overshadows the purely physiological consideration. The athletic class will never exceed ten or fifteen per cent. of a college community, and it is after all for the main body of students whose interests are not primarily athletic that physical instruction must be considered and its details planned so that they may be enabled to graduate stronger,

sounder, more self reliant and more efficient.

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ON THE PHYSIOLOGICAL EFFECTS OF MODERATE MUSCULAR ACTIVITY AND OF STRAIN[1]

Practical efforts, both in Europe and America, to solve the problem of physical training in schools and colleges have proceeded along two different lines, which are roughly typified in Europe by the English system, on the one hand, and the Swedish and German systems, on the other. In the former, athletic efforts may be said to play a predominant rôle; in the latter, they are strictly subordinated in the endeavor to reach the masses. Similarly, the practise in America differs considerably. In some colleges the great stress is laid upon athletics; in others athletic activities are entirely separate from instruction in physical training for the student body as a whole. But these are the extremes, for in the majority of cases the organization of the work combines, or seeks to combine, both. Perhaps it will be conducive to clearer thinking if we define at the outset the difference between the two extremes.

In those cases where athletics are under separate organization and control, it is the aim of the department of physical training to secure for each individual student the proper basis of health for his work in school or college and also to educate him in the truest sense of that word for the proper hygienic conduct of his subsequent life. Physical training is not regarded as an end in itself, but as an essential means toward the equipment of the individual for the work in which he may engage. The effort is, furthermore, made to do this economically as regards both time and effort.

The athletic ideal is entirely different. It does constitute at the time an end in itself; its primary purpose is not the cultivation of health, but of excelling some one else. It brings into play the elements of competition and championship. The athletic team of a school or college represents the best which the institution can do in that line of effort. Sacrifices of time, of convenience, and, generally, to some extent at least, of scholarship, are regarded as proper, if needed to secure the immediate end in view. Physical risks must be taken if necessary, risks which may end in permanent injury, and even in death, in order that one's college shall prove itself superior to some other college.

There are thus, these two ideals which come into practical work of physical training. It is of course not necessary that we adopt one to the exclusion of the other; but these ideals profoundly influence the practical measures adopted, and it is essential that we approach the solution of our problem from the right point of view. It should be added that, in giving each its due weight, other considerations than the strictly hygienic must enter into our decision. First, there is the question whether a given plan of action reaches the masses and is effective with them from the standpoint of physical training; and there is also the question whether we do not need to cultivate those moral qualities of group loyalty, of subordination of self to the interest of the whole, and of the willingness to make the supreme effort for a common cause, which is perhaps the very soul of modern school and college athletics. These are questions on which obviously the physiologist has not the last word,

[1] An address delivered in a symposium on "The Regulation of Physical Instruction in Schools and Colleges, from the Standpoint of Hygiene" before Section K (Physiology and Experimental Medicine) of the American Association for the Advancement of Science, Baltimore, December 20, 1908.

although he must have an important share in their answer.

Returning to the strictly hygienic side of the question, I am simply trying to get clear in your minds the fact that there are these two ideals and that one of them involves the necessity of training for and, at times, the making of a supreme physical effort on the part of the contestant. The other does not involve this element; on the contrary, perhaps it generally seeks to avoid it, thus leaving the individual free to concentrate his effort on some other object.

Now, whether we attempt or do not attempt to include these elements of moral education in our efforts at physical training, it is of first importance that we secure the hygienic ends and that our work be successful with the masses and not solely with those who finally engage in athletic contests. Not only this, but, viewing physical training as a part of education as a whole, it is even fair to demand of it that it do more than provide the physical capital for the work of life by securing the proper development of the body during the period of youth; it should also lay the foundation of correct habits; it should leave the student with the ability to enjoy those forms of physical activity which are possible amid the more serious concerns of adult life, and with a compelling belief in the necessity, even the obligation, of maintaining the physical man.

With this in mind, let us review rapidly the biological requirements of the human body for muscular activity as an essential factor in health. In this audience, it would be only to state a truism to say that the human frame is constructed for a life of muscular activity; that the fact that, until very recently, mankind has supported itself by physical rather than by mental exertion must have led to the survival of those with bodies adapted to physical exertion. So essential was it that this adaptation should be of a very high order, that we are not surprised to find that it went to the extent of producing a body not only capable of sustaining, but even of profiting by, physical exertion.

Assuming that this adaptation of the organism for muscular activity is the result of a hard process of natural selection, we should expect to find that the extent of the adaptation is determined by its survival value; that is to say, it would not be reasonable to expect adaptation of the race as a whole to degrees or forms of muscular exertion which formed no part of the daily life of the average man or woman, and we may assume to-day that the race as a whole is not likely to profit by forms of activity distinctly more strenuous than those to which it has been accustomed in the past.

"The muscular activity which thus formed part of the life of our ancestors may be described as generally moderate, though at times it was vigorous or hard; only exceptionally did it involve extreme endurance or great muscular strain. . . . Where work of this kind had to be done it was left to those who, by reason of exceptional strength, were especially fitted for it."[2] It would seem that it is to such work that the race, as a whole, is adapted and there is thus a strong *a priori* theoretical probability that it is by such work that it is most benefited. In using the term "moderate muscular activity" in this discussion, you will understand that I am referring to work of this kind. And it is sufficiently obvious that the training for beating a record, or for rowing, or football is something distinctly in excess of this.

Through what physiological channels

[2] Hough and Sedgwick, "The Human Mechanism," p. 312.

does this moderate muscular activity minister to the health of the body? We can not discuss this at any length here, and to do so would only be to repeat what has been explained over and over again. But we may mention the following as the principal hygienic effects.

1. Muscular activity affords training to the heart, so that it is not only equal to the emergencies of life, but is also able to withstand the fatigue of moderate prolonged exertion. No exercise can be enjoyed unless this fundamental condition is satisfied.

2. Muscular activity relieves vascular congestions in the internal organs by bringing larger quantities of blood to the skin. In doing this it improves the physiological condition of the skin, as well as that of deeper organs.

3. As a result of the deepened and frequently quickened respiration all lobes of the lungs are used and the apical lobes rendered less liable to the attacks of disease.

4. As a further result of the increased breathing movements, as well as of the pumping action of contracting muscles and movements at joints, the flow of lymph along the lymphatics is greatly favored, and this improves the environmental condition of all cells of the body.

5. Muscular activity also affords important training to the heat-regulating mechanism of the body.

6. Muscular activity exerts a favorable influence upon the digestive processes, promoting proper secretion and absorption and tending to prevent the unhealthful conditions leading to constipation.

7. Muscular activity is conducive to refreshing slumber. This is partly because of the maintenance of normal conditions in the body generally and probably, in part, because it is conducive to the healthful fatigue which facilitates the normal relaxation from nervous strain. Whatever may be the physiological explanation of the phenomenon, there can be no question of its existence and of its hygienic value to the nervous system.

It is not essential to our purpose that we make a complete list of these favorable physiological effects. Probably the above comprises the more important of them, and before leaving this part of our subject we may point out two things. First: these are all hygienic essentials and most, if not all, of them can be properly secured only by muscular activity. The training of the heart, the maintenance of deepened breathing without depriving the blood of its due charge of carbon dioxide, the favorable effect on the flow of lymph—for it is an old physiological observation that there is no lymph flow from the limbs when motionless—the favorable effects on digestive functions and on slumber, all of these can be secured in *no other way* than by muscular activity. This means that physical training is an essential in any properly planned course of education and that no school or college is justified on any ground whatsoever in failing to provide properly for this need of its students. Second: all these hygienic effects can be secured by what we have termed "moderate" exercise. Not one of them requires the effort involved in training for athletic events. This fact seems to me to justify a statement which I have made elsewhere to the effect that "the athletic ideal is not the hygienic ideal; it may not be unhygienic, but it is not required for purposes of health."

But athletic training and athletic contests may be at least desirable and possibly necessary for other than hygienic purposes; and so the question at once presents itself whether in using it for these purposes unjustifiable risks to health are

taken. What are the physiological effects of the training for and the participation in such efforts?

The contribution of the physiologist to the answer to this question must be limited to a statement of what is known of the physiological conditions during strain. It is for the clinician to tell us how far these dangers actually produce ill effects; and the clinical evidence, to be at all satisfactory, must be drawn, not simply from the study of cases which apply for treatment, but from a systematic study of an entire group of *average* people participating in such work. For it must be remembered that the appeal of athletics is not simply to those who will finally make a school or college team, but to a much larger proportion of the student body.

First, I think we should make sure that we appreciate the weight of the burden of physiological adjustment which muscular activity places upon the organism, for this is always greater than is generally supposed. It may be measured with a fair degree of accuracy by the respiratory exchange, since this varies almost *pari passu* with the work. The comparison must, however, be made between the expired air, collected directly from the respiratory passages, during rest and during the actual performance of work. Measurements made in respiration chambers, unless the work extends over several hours (and very severe work can not be maintained continuously for this length of time), necessarily involve some lag in the collection of the samples. I will quote from two reliable observations involving such direct analyses of the expired air.

Leo Zuntz[3] found that the oxygen consumed per minute while riding a bicycle on a level asphalt track at a speed of nine miles an hour increased from 263 c.cm. (during rest) to 1,550 c.cm., and that when the speed was increased to thirteen miles an hour it rose to 2,058 c.cm., an increase of eightfold. This corresponds very closely with what Zuntz and Lehmann[4] had previously found for the horse, where the oxygen consumed and the carbon dioxide excreted per minute increased from five to ten fold with moderately heavy to hard work, respectively. All observations, moreover, show that this respiratory need must be met at once, which means an enormous increase of work on the part of the respiratory and vascular systems. When we find the muscular work of the sitting posture almost doubling that of the sleeping condition; even light activity doubling the work of the sitting posture; only moderately heavy work increasing it four or five fold, while vigorous activity increases it eight and ten fold; and when we reflect that all this must be immediately provided for in the successful readjustment of the circulation and respiration—we begin to appreciate the possibilities of physical strain.

Two very different forms of muscular activity introduce into the organism conditions of strain and the nature of the strain in the two cases is very different; first, when a supreme effort is put forth suddenly and for comparatively brief periods of time, as in the hundred yards' dash; and, second, where vigorous but less violent exertion is prolonged over a much greater time, as in long-distance running. Probably the chief dangers in the two cases are, respectively, excessive arterial pressure, at times combined with disturbance of the pumping action of the heart, and fatigue.

With regard to arterial pressure during muscular activity, the reliable data at hand are sufficient to give us an idea of

[3] Leo Zuntz, "Untersuchungen über den Gaswechsel und Energieumsatz des Radfahrers."

[4] Zuntz and Lehmann, "Stoffwechsel des Pferdes," Berlin, 1889.

the possible strain which may at times be placed upon the heart and arteries, but they do not give us the knowledge we should have of the pressure conditions during fatigue. It is clear enough that in the increased output from the heart and the probable constriction of the arterioles of the splanchnic and other internal organs pressor factors are introduced, while in the dilation of muscular and cutaneous arterioles depressor factors are introduced; through the changes of thoracic aspiration and the rhythmic pressures on the bloodvessels of the working muscle and moving joints, arterial pressure must also be influenced, the exact direction of the influence probably differing with the nature of the exercise and the condition of the organism. Finally, where very rapid rhythmic or sustained contractions are made, the blocking of the circulation through the muscles must exert a marked depressor influence. The net result must be the algebraic sum of these pressor and depressor influences and we are prepared to find, as we actually do, considerable variations of result. Thus Zuntz and Hagemann[5] found in the horse a slight fall of mean pressure, but sometimes a slight rise with moderate work. In the dog, on the other hand, Tangl and Zuntz[6] always found a rise of from 20 to 30 mm. of mercury with active exercise; but when the dog was made to run very rapidly in the treadmill so that distinctly labored breathing developed, enormously high mean pressures of 275 mm. of mercury were recorded. In the latter case, the relaxation period of the muscle was probably not long enough to permit the blood to flow through in any quantity, so that the great muscular outlet from the aorta was temporarily blocked off. These direct measurements, however, suffice to show that moderate muscular activity causes only a slight change of mean arterial pressure and that change usually an increase of from 20 to 30 millimeters of mercury; but that certain forms of muscular activity may result in pressures which must be looked upon as distinctly dangerous.

Upon man I would next call attention to Bowen's[7] very careful measurements of systolic pressure, during work on a stationary bicycle, the work being described as "just vigorous enough to satisfy the needs of a healthy man who is not in training for athletics." He found that the systolic pressure rose from 130 mm. of mercury to a maximum of 180 mm. within the first five or ten minutes; after this there was a fall to a plateau of 165 or 170 mm., or even a continuous but gradual fall throughout the thirty-five minutes of the work. After the cessation of the work there was a sudden fall to or even below the normal, followed by a return to normal within ten minutes. Those interested in the subject will find Bowen's paper very suggestive.

Lastly I should mention McCurdy's[8] measurements of systolic pressure during the maximal effort of the ordinary gymnasium test of strength of legs. The pressure was first raised in the brachial armlet to 500 mm. of mercury, or thereabouts, and then rapidly lowered during the effort until the radial pulse could be felt. This method would give somewhat low records for systolic brachial pressure, but even then pressures of from 175 to 265 mm. of mercury were recorded. The form of effort reproduced the conditions of

[5] Zuntz and Hagemann, "Stoffwechsel des Pferdes," 387 foll, Berlin, 1898.

[6] Tangl and Zuntz, *Pflüger's Archiv*, LXX., 554, 1898.

[7] Bowen, *American Journal of Physiology*, XI., 59, 1904.

[8] McCurdy, *American Journal of Physiology*, V., 95, 1901.

forced expiration with closed glottis and it was found that this act alone (without the lifting) caused a similar rise. I can confirm this statement from experiments made in my own laboratory.

These facts are enough to show the extent to which certain forms of muscular activity may raise arterial pressure and we can not but regard this condition, even in the young, as a source of danger. The risk of cardiac dilatation, valvular insufficiency and injury to the arterial wall have been frequently pointed out, and it does not seem that the need for the utmost caution is put aside by the argument that investigation fails to show bad effects on health among those who have engaged in athletic contests in the past. Meylan's[9] very careful and satisfactory study of the Harvard oarsmen from 1852 to 1892, inclusive, undoubtedly shows marked freedom of these men from cardiac or other vascular troubles in later life, and force the conclusion that this most vigorous of athletic trainings is consistent with the subsequent good health of those who "make the crews." But these are the picked men, physically, of the university and the facts only show that with proper training and under proper medical supervision these picked men may engage in such work without harmful after-effects. But it is one thing to supply adequate medical supervision to a team or crew, and quite a different thing to supply it to a large student body engaging in athletic training; for no medical supervision can be regarded as adequate unless it detects the signs of mischief before it has gone beyond the possibility of repair. In the absence of such supervision it is simply common every-day prudence to keep physical effort well within the bounds of safety. The best gymnasium instructors watch carefully for signs of strain, such as skin pallor, labored breathing and the like, during a run and diminish at once the intensity of the work. And in doing so they are only putting into practise the hygienic principle which we have already drawn from the consideration of the probable extent of adaptation of the race as a whole to muscular activity. The average man or woman, the average boy or girl, is not adapted for extreme effort, and it is not proved by experiment or experience that, in such cases, training can supply what heredity has failed to furnish.

Passing to the second condition of strain imposed upon the organism by athletic activities, that of vigorous but not supreme effort continued over longer periods of time, I shall cite only the observations[10] made for three years upon contestants in the Marathon Race held annually under the auspices of the Boston Athletic Association. These show that at the close of the twenty-four mile race (two and one half to three hours) there was always an enlargement of the heart with a systolic murmur (which, however, Larrabee hesitates to attribute to mitral incompetence), that all the signs pointed toward lowered mean blood-pressure; that the blood counts showed "a leucocytosis corresponding in intensity and type with that observed in various inflammatory diseases"; and that the urine invariably contained traces of albumin and more or less blood.

This presents to us the picture of the organism struggling with the conditions of marked general fatigue, especially in the working of the heart and of the vasomotor mechanism. The circulation is being maintained under extremely unfavorable conditions and presents every sign of venous congestion with its resulting inter-

[9] Meylan, "Harvard University Oarsmen," *Harvard Graduates' Magazine* and *American Physical Education Review*, March and June, 1904.

[10] Blake, Larrabee and others, *Boston Medical and Surgical Journal*, CLXVIII., 195, 1903.

ference in the work of the kidneys. It should also be pointed out that even though arterial pressure is subnormal, yet a weakened heart working against comparatively low pressure may be in as great danger as a strong and fresh heart working against high pressure. The conditions may, it is true, be only transitory; they may pass away without lasting ill effects; but they are all distinctly unfavorable conditions in the organism, and we are not justified in looking upon them as other than warnings which must be heeded in formulating proper systems of physical training for the masses.

It is, of course, easy to exaggerate these dangers and it is difficult even to state them clearly and fairly without running the risk of being misunderstood. I should be the last man in the world to advocate the banishment of athletic activities from college life. I would not be understood to discourage new forms of physical exercise merely because they are new and have not formed part of the ancestral activities to which the adaptation of the organism is most perfect. I believe in the active life, in the cultivation of greater physical strength and endurance with all classes and all ages; but let us do this with full understanding of the risks involved, always with due reference to securing in each individual the maximal efficiency in subsequent life, and above all with the determination to provide for the masses the best possible physical training.

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CURRENT PROGRESS IN CONSERVATION WORK

THE Proceedings of the Conference of Governors on the conservation of the natural resources of the country, held in the White House, Washington, May 13–15, 1908, have just been issued in a volume of xxxv + 451 pages. The bulk of the edition is distributed by senators and representatives; the smaller portion designed for distribution by the President among the governors and other conferees is in course of distribution under the direction of ex-President Roosevelt by the Joint Committee on Conservation (Hon. Gifford Pinchot, chairman).

The National Conservation Commission, appointed by the President on June 8 last pursuant to action at the Governors' Conference, held a working session during the first week in December last, at which an inventory of the resources of the country was discussed and a report adopted; during the second week in December the inventory and report were considered at the Joint Conference of State and National commissions and commissions or committees appointed by national organizations. The Joint Conference approved and supplemented the papers, which were duly submitted to the President and were by him in January transmitted to Congress with an approving message. The inventory is the most complete quantitative statement of natural resources ever prepared for any country. After some delay, publication was authorized by Congress, and the matter is now in type and undergoing proof revision. It will form two volumes, aggregating some 1,700 pages. Provision has not yet been made for adequate distribution.

The complete preliminary Report of the Inland Waterways Commission (which body arranged for the Governors' Conference and the subsequent steps in the conservation movement) has been in the hands of the printer for several months, completion being delayed by extensive proof revision, especially of the extended statistical matter prepared in the office of Hon. Herbert Knox Smith, Commissioner of Corporations. The matter is now on

the press, and will be issued within a few days in a volume of vii + 703 pages. The bulk of the edition will be distributed by senators and representatives; a limited number of copies being held for the use of experts.

Pursuant to the Joint Conference in December, President Roosevelt invited Canada and Mexico to join the United States in a joint movement for taking stock of the natural resources of the North American continent. The neighboring nations accepted with alacrity, and each designated three commissioners to meet in Washington with a like number of American commissioners on February 18; and at the instance of the British Ambassador the colony of Newfoundland was also represented. This "North American Conservation Conference" was signally harmonious, and constructive ideas prevailed throughout the deliberations. These continued until February 23, and resulted in the appended *Declaration of Principles*.

A specially noteworthy feature is the unanimous opinion that the time has come for rendering the conservation movement world-wide in scope. When this opinion was submitted to President Roosevelt, he promptly responded by addressing invitations to all civilized nations to join in a conference devoted to consideration of the world's natural resources, to be held at The Hague at such date as may be found generally convenient—if practicable, about September next. Replies (without exception favorable) are arriving in due course; the French government has already taken formal action, and several other nations have announced that action is under way.

During the closing days of the Sixtieth Congress the following amendment was added to the Sundry Civil Bill:

Sec. 9. That hereafter no part of the public moneys, or of any appropriation heretofore or hereafter made by Congress, shall be used for the payment of compensation or expenses of any commission, council, board, or other similar body, or any members thereof, or for expenses in connection with any work or the results of any work or action of any commission, council, board, or other similar body, unless the creation of the same shall be or shall have been authorized by law; nor shall there be employed by detail, hereafter or heretofore made, or otherwise personal services from any executive department or other government establishment in connection with any such commission, council, board or other similar body.

When the bill was enacted and submitted to the President for signature, he disapproved this item in a memorandum attached to and forming a part of the Act (and which has received wide attention through the press), as follows:

I have hesitated long before affixing my signature to this bill, and if it were earlier in the session, or if the bill contained a less number of important propositions of benefit to the country, I should certainly not sign it. Moreover, if section 9 of the bill, to which I subsequently refer, were operative according to its evident intent, I should be forced to veto the bill anyhow. But I have concluded that this section is not operative to the extent that its framers evidently hoped, and that the mischief it will cause, though appreciable, can be sufficiently remedied by the action of the Executive to warrant my permitting the bill to become a law, in view of all the considerations surrounding the case.

. . . .

Section 9 of the act contains a provision far more damaging to the interests of the public. This attempts to prohibit the use of any government funds or the detail of any government clerks to help the work of any commission, council or board, unless the same is specifically authorized by previous congressional action. This could certainly only result in hampering efficient government work. But as the purpose of the attempt in its entirety is clearly an invasion of executive prerogative, and unconstitutional and void, it is only very partially successful. The provision is obviously aimed at such commissions or boards as, for instance, the Conservation Commission, the Country Life Commission, the Council of Fine Arts, the General Board of the Navy and the Joint Board of the Army and Navy, not to speak of such boards as the National Advisory Board on Structural Material, the board of reference in

connection with the pure food law and scores of others, none of which were first authorized by Congress, but all of which were called together by the Executive for the purpose of public service; for the purpose of rendering to our people sorely needed service which could not and would not otherwise have been rendered. So far as the various army and navy boards are concerned, the attempt is fortunately futile, and represents merely failure in an effort to subordinate purely military and national considerations to small personal or political considerations. The President has under the Constitution the sole power to direct the use of the officers of the army and navy, always provided he acts within the limits set by the Constitution. The Congress can no more forbid the President to use the services of officers or employees when they act in concert as a board or council than it can forbid him to use their services when they act as individuals.

The chief object of this provision, however, is to prevent the Executive repeating what it has done within the last year in connection with the Conservation Commission and the Country Life Commission. It is for the people of this country to decide whether or not they believe in the work done by the Conservation Commission and by the Country Life Commission. If the people of this country do not believe in the conservation of our natural resources; if they do not believe in developing our waterways and protecting our forests; if they do not believe in the betterment of life on the farm, and in upholding the interests of the farmers; if they are willing to go on in the old course of squandering the effects of our children's children; then they will uphold the action of those in Congress who are responsible for this provision. If they believe in improving our waterways, in preventing the waste of soil, in preserving the forests, in thrifty use of the mineral resources of the country for the nation as a whole rather than merely for private monopolies, in working for the betterment of the condition of the men and women who live on the farms, then they will unstintedly condemn the action of every man who is in any way responsible for inserting this provision, and will support those members of the legislative branch who opposed its adoption. I would not sign the bill at all if I thought the provision entirely effective. But the Congress can not prevent the President from seeking advice. Any future President can do as I have done, and ask disinterested men who desire to serve the people to give this service free to the people through these commissions. This action taken by the Congress hampers and renders more difficult the work of such commissions, and entails a greater sacrifice in time and money upon the public-spirited men who disinterestedly and without any recompense have served or may serve on these commissions. But the Congress can only hamper and render more difficult, it can not stop this work. The Executive can continue to appoint these commissions and can make exactly the use of them that I have made in the past, although, owing to the Congress, a greater burden will be put upon them.

The republican platform last year said: "We endorse the movement inaugurated by the administration for the conservation of natural resources. . . . No obligation of the future is more insistent and none will result in greater blessings to posterity." The democratic platform said: "We repeat the demand for internal development and for the conservation of our natural resources, the enforcement of which Mr. Roosevelt has . . . sought."

My successor, the President-elect, in a letter to the Senate Committee on Appropriations, asked for the continuance and support of the Conservation Commission. The Conservation Commission was appointed at the request of the governors of over forty states, and almost all of these states have since appointed commissions to cooperate with the national commission. Nearly all the great national organizations concerned with natural resources have been heartily cooperating with the commission.

With all these facts before it, the Congress has refused to pass a law to continue and provide for the commission; and it now passes a law with the purpose of preventing the Executive from continuing the commission at all. The Executive, therefore, must now either abandon the work and reject the cooperation of the states, or else must continue the work personally and through executive officers whom he may select for that purpose.

When I speak of the Congress I, of course, mean those members of the Congress who are responsible for this provision of the bill, and I emphatically do not mean those public-spirited members who have striven to prevent the incorporation in the bill of this provision. To the Congressmen who in this and similar matters have stood by the interests of the public, the interests of those whom Abraham Lincoln called "the plain people," the heartiest support is owing. But I call the atten-

tion of those who are responsible for putting in this provision to a fundamental fact which is often ignored in discussing and comparing the action of the executive and the action of the legislative branches of the government. Neither one is responsible to the other. Each must act as its wisdom dictates. But each is responsible to the people as a whole. It is for the people to decide whether they are represented aright by any given servant; and one element in enabling them to reach a decision must be that public servant's record in such a case as this.

At the Joint Conference on Conservation, in December, a resolution was offered providing for a joint committee of nine to prepare a plan of cooperation among conservation commissions, six members to be appointed from state commissions and three from the National Commission; in the course of discussion, provision was made for including also the chairman and secretary of the latter body (Hon. Gifford Pinchot and Mr. Thomas R. Shipp) and in this form the resolution was adopted. The first formal meeting of this joint committee was set for March 5; and on that and the ensuing day the committee met and framed a plan for joint work which will be circulated during the present month. On March 6 several members of the committee, headed by ex-Governor Pardee, of California, and accompanied by Governors Deneen, of Illinois, Willson, of Kentucky, and Quinby, of New Hampshire, submitted the general plan for continuing the conservation work to President Taft, who reiterated his frequently expressed intention of continuing the task begun by his predecessor, and using every effort to secure legislative action. In the course of the meeting of the Joint Committee on Conservation, it was found that thirty-seven states have appointed state conservation commissions, and that some thirty organizations of national character have appointed committees of like character and purpose. Definite arrangements were made for coordinating the work of these organizations in such manner as to yield increasingly accurate inventories of the natural sources of national prosperity and perpetuity. Messrs. Pinchot and Shipp, respectively, were made chairman and secretary of the committee, and headquarters were established in the Wyatt building, Washington, D. C.

W J MCGEE

NORTH AMERICAN CONSERVATION CONFERENCE DECLARATION OF PRINCIPLES

We recognize the mutual interests of the nations which occupy the continent of North America and the dependence of the welfare of each upon its natural resources. We agree that the conservation of these resources is indispensable for the continued prosperity of each nation.

We recognize that the protection of mutual interests related to natural resources by concerted action, without in any way interfering with the authority of each nation within its own sphere, will result in mutual benefits, and tend to draw still closer the bonds of existing good will, confidence and respect. Natural resources are not confined by the boundary lines that separate nations. We agree that no nation acting alone can adequately conserve them, and we recommend the adoption of concurrent measures for conserving the material foundations of the welfare of all the nations concerned, and for ascertaining their location and extent.

We recognize as natural resources all materials available for the use of man as means of life and welfare, including those on the surface of the earth, like the soil and the waters; those below the surface, like the minerals; and those above the surface, like the forests. We agree that these resources should be developed, used and conserved for the future, in the interests of mankind, whose rights and duties to guard and control the natural sources of life and welfare are inherent, perpetual and indefeasible. We agree that those resources which are necessaries of life should be regarded as public utilities, that their ownership entails specific duties to the public, and that as far as possible effective measures should be adopted to guard against monopoly.

Public Health.—Believing that the conservation movement tends strongly to develop national efficiency in the highest possible degree in our respective countries, we recognize that to accom-

plish such an object with success, the maintenance and improvement of public health is a first essential.

In all steps for the utilization of natural resources considerations of public health should always be kept in view.

Facts which can not be questioned demonstrate that immediate action is necessary to prevent further pollution, mainly by sewage, of the lakes, rivers and streams throughout North America. Such pollution, aside from the enormous loss in fertilizing elements entailed thereby, is an immediate and continuous danger to public health, to the health of animals, and, when caused by certain chemical agents, to agriculture. Therefore we recommend that preventive legislation be enacted.

Forests.—We recognize the forests as indispensable to civilization and public welfare. They furnish material for construction and manufacture, and promote the habitability of the earth. We regard the wise use, effective protection, especially from fire, and prompt renewal of the forests on land best adapted to such use, as a public necessity and hence a public duty devolving upon all forest owners alike, whether public, corporate or individual.

We consider the creation of many and large forest reservations and their permanent maintenance under government control absolutely essential to the public welfare.

We favor the early completion of inventories of forest resources, in order to ascertain the available supply and the rate of consumption and reproduction.

We recommend the extension of technical education and practical field instruction in forest conservation, afforestation and reforestation, so as to provide efficient forest officers whose knowledge will be available for necessary public information on these subjects.

Believing that excessive taxation on standing timber privately owned is a potent cause of forest destruction by increasing the cost of maintaining growing forests, we agree in the wisdom and justice of separating the taxation of timber land from the taxation of the timber growing upon it, and adjusting both in such a manner as to encourage forest conservation and forest growing.

We agree that the ownership of forest lands, either at the headwaters of streams or upon areas better suited for forest growth than for other purposes, entails duties to the public, and that such lands should be protected with equal effectiveness, whether under public or private ownership.

Forests are necessary to protect the sources of streams, moderate floods and equalize the flow of waters, temper the climate and protect the soil; and we agree that all forests necessary for these purposes should be amply safeguarded. We affirm the absolute need of holding for forests, or reforesting, all lands supplying the headwaters of streams, and we therefore favor the control or acquisition of such lands for the public.

The private owners of lands unsuited to agriculture, once forested and now impoverished or denuded, should be encouraged by practical instruction, adjustment of taxation, and in other proper ways, to undertake the reforesting thereof.

Notwithstanding an increasing public interest in forestry, the calamitous and far-reaching destruction of forests by fire still continues and demands immediate and decisive action. We believe that systems of fire guardianship and patrol afford the best means of dealing adequately with fires which occur, whether from natural causes, such as lightning, or in other ways; but we affirm that in addition thereto effective laws are urgently needed to reduce the vast damage from preventable causes.

Apart from fire, the principal cause of forest destruction is unwise and improvident cutting, which, in many cases, has resulted in widespread injury to the climate and the streams. It is therefore of the first importance that all lumbering operations should be carried on under a system of rigid regulation.

Waters.—We recognize the waters as a primary resource, and we regard their use for domestic and municipal supply, irrigation, navigation and power as interrelated public uses and properly subject to public control. We therefore favor the complete and concurrent development of the streams and their sources for every useful purpose to which they may be put.

The highest and most necessary use of water is for domestic and municipal purposes. We therefore favor the recognition of this principle in legislation and, where necessary, the subordination of other uses of water thereto.

The superior economy of water transportation over land transportation, as well as its advantages in limiting the consumption of the non-renewable resources, coal and iron, and its effectiveness in the promotion of commerce, are generally acknowledged. We therefore favor the development of inland navigation under general plans adapted

to secure the uniform progress of the work and the fullest use of the streams for all purposes. We further express our belief that all waterways so developed should be retained under exclusive public ownership and control.

We regard the monopoly of waters, and especially the monopoly of water power, as peculiarly threatening. No rights to the use of water powers in streams should hereafter be granted in perpetuity. Each grant should be conditioned upon prompt development, continued beneficial use, and the payment of proper compensation to the public for the rights enjoyed; and should be for a definite period only. Such period should be no longer than is required for reasonable safety of investment. The public authority should retain the right to readjust at stated periods the compensation to the public and to regulate the rates charged, to the end that undue profit or extortion may be prevented.

Where the construction of works to utilize water has been authorized by public authority and such utilization is necessary for the public welfare, provision should be made for the expropriation of any privately owned land and water rights required for such construction.

The interest of the public in the increase of the productiveness of arid lands by irrigation and of wet lands by drainage is manifest. We therefore favor the participation of the public to secure the complete and economical development and use of all water available for irrigation and of all lands susceptible of profitable drainage, in order to ensure the widest possible benefit. Special projects should be considered and developed in connection with a general plan for the same watershed. In the matter of irrigation, public authority should control the headwaters and provide for the construction of storage reservoirs and for the equitable distribution and use of the stored water.

Lands.—We recognize land as a fundamental resource, yielding the materials needed for sustaining population, and forming the basis of social organization. Increase in the productivity of the soil is a growing need, and the possession of the land by the men who live upon it not only promotes such productivity, but is also the best guarantee of good citizenship. In the interest of the homemaker, we favor regulation of grazing on public land, the disposal of public lands to actual settlers in areas each sufficient to support a family, and the subdivision of excessive holdings of agricultural or grazing land, thereby preventing monopoly.

The preservation of the productivity of the soil is dependent upon rotation of crops, fertilization by natural or artificial means and improved methods in farm management. The quantity and quality of crops are also dependent upon the careful selection of seed. We therefore favor the distribution by government bureaus of scientific and practical information on these points, and we urge upon all farmers careful attention thereto.

The national importance for grazing of non-irrigable public lands too dry for cultivation and the public loss occasioned by overgrazing are generally acknowledged. We therefore favor government control of such lands in order to restore their value, promote settlement and increase the public resources.

The first requisite for forest or other covering which will conserve the rainfall and promote regularity of water flow is the retention of the soil upon watersheds. We therefore favor the construction of such artificial works as may effect this purpose and the encouragement thereof by remission of taxes, government cooperation, or other suitable means.

Minerals.—We recognize the mineral resources as forming the chief basis of industrial progress, and regard their use and conservation as essential to the public welfare. The mineral fuels play an indispensable part in our modern civilization. We favor action on the part of each government looking towards reduction of the enormous waste in the exploitation of such fuels, and we direct attention to the necessity for an inventory thereof. Such fuels should hereafter be disposed of by lease under such restrictions or regulations as will prevent waste and monopolistic or speculative holding, and supply the public at reasonable prices.

We believe that the surface rights and underground mineral rights in lands should be separately dealt with so as to permit the surface of the land to be utilized to the fullest extent, while preserving government control over the minerals.

Regulations should be adopted looking to the most economical production of coal and other mineral fuels and the prolongation of the supply to the utmost. We favor also the substitution of water power for steam or other power produced by the consumption of fuel.

Great economy in the use of fuel has resulted in the past from the application of scientific inventions and the use of improvements in machinery, and further progress can be made in the same direction. We therefore recommend that all possible encouragement and assistance be given in

the development and perfecting of means whereby waste in the consumption of fuel can be reduced.

The loss of human life through preventable mining accidents in North America is excessive. Much needless suffering and bereavement results therefrom. Accompanying this loss there is great destruction of valuable mineral property and enhancement of the cost of production. The best method of eliminating these known and admitted evils lies in the enactment and strict enforcement of regulations which will provide the greatest possible security for mine workers and mines. We therefore favor the scientific investigation of the whole subject of mine accidents by the governments participating in this conference, the interchange of information and experience and the enactment and enforcement of the best regulations that can be devised.

Mineral fertilizers should not be monopolized by private interests, but should be so controlled by public authority as to prevent waste and to promote their production in such quantity and at such price as to make them readily available for use.

Protection of Game.—We recognize that game preservation and the protection of bird life are intimately associated with the conservation of natural resources. We therefore favor game protection under regulation, the creation of extensive game preserves and special protection for such birds as are useful to agriculture.

Conservation Commissions.—The action of the President of the United States in calling this first conference to consider the conservation of the natural resources of North America was in the highest degree opportune, and the proceedings which have followed, and the information mutually communicated by the representatives assembled, have, we believe, been conducive to the best interests of the countries participating. To derive the greatest possible benefit from the work which has already been done, and to provide proper and effective machinery for future work, there should be established in each country a permanent conservation commission.

When such conservation commissions have been established, a system of intercommunication should be inaugurated, whereby, at stated intervals, all discoveries, inventions, processes, inventories of natural resources, information of a new and specially important character, and seeds, seedlings, new or improved varieties, and other productions which are of value in conserving or improving any natural resource shall be transmitted by each commission to all of the others, to the end that they may be adopted and utilized as widely as possible.

World Conservation Conference.—The conference of delegates, representatives of the United States, Mexico, Canada and Newfoundland, having exchanged views and considered the information supplied from the respective countries, is convinced of the importance of the movement for the conservation of natural resources on the continent of North America, and believes that it is of such a nature and of such general importance that it should become worldwide in its scope, and therefore suggests to the President of the United States of America that all nations should be invited to join together in conference on the subject of world resources and their inventory, conservation and wise utilization.

Gifford Pinchot,
Robert Bacon,
James R. Garfield,
Commissioners Representing the United States.

Sydney Fisher,
Clifford Sifton,
Henri S. Béland,
Commissioners Representing the Dominion of Canada.

Rómulo Escobar,
Miguel A. de Quevedo,
Carlos Sellerier,
Commissioners Representing the Republic of Mexico.

E. H. Outerbridge,
Commissioner Representing the Colony of Newfoundland.

Attest:
Robert E. Young,
Thomas R. Shipp,
Secretaries of the Conference.
Washington, D. C., February 23, 1909

SCIENTIFIC NOTES AND NEWS

The centenary of the birth of Darwin was commemorated at Syracuse University on March 19, by a meeting held under the auspices of the Syracuse Chapter of Sigma Xi, the Onondaga Academy of Science, the Syracuse Academy of Medicine, the Syracuse Botanical Club, the University Biological Association and the University Geological Club. Addresses were made as follows: "Darwin and Zoology," by Professor Charles W. Hargitt; "Darwin and Botany," by Professor William L. Bray; "Darwin and Geology," by Dr. John M. Clarke, state geologist, Albany.

Washburn College and the Kansas Academy of Science celebrated the centenary of

Darwin's birth on March 26, the program being: "Darwinism and Experimentation," Dr. D. T. MacDougal, director, department botanical research, Carnegie Institution of Washington; "Evolution of Organisms in Relation to Environment," Professor W. L. Tower, department of zoology, University of Chicago.

THE Wellesley College Science Club held its one hundredth meeting on March 9 in the Whitin Observatory, when the program was devoted to Charles Darwin. Dr. Robertson gave an account of the status of biology before Darwin's time and the changes wrought by him. Dr. Ferguson followed, giving an account of the influence of Darwin's work on botanical science. Dr. Wiegand then gave a paper on "Modern Theories of the Origin of Species and their Relation to Natural Selection." Professor Hayes was the last speaker.

DARWIN memorial exercises were held at the Michigan Agricultural College on March 4, with the following program: "Early Impressions of Darwinism," Dr. W. J. Beal; "Darwin, the Worker," Professor W. B. Barrows; "Darwin's Influence on Thought," Dr. R. M. Wenley.

THE daily papers state that it is proposed to offer the ambassadorship to Great Britain to President Eliot after his retirement from the presidency of Harvard University. Mr. Eliot, who is at present making addresses in the south, reached his seventy-fifth birthday on March 20.

A BANQUET in honor of President Angell was given in New York City on March 19 by alumni of the University of Michigan.

THE seventh annual meeting of the South African Association for the Advancement of Science will be held at Bloemfontein at the end of September under the presidency of Sir Hamilton J. Goold-Adams.

DR. SVEN HEDIN has lectured in the presence of Emperor William before the Berlin Geographical Society, which awarded to him its Humboldt medal. He has also lectured at the Sorbonne, Paris.

PROFESSOR W. M. DAVIS, of Harvard University, has finished his courses at Berlin and has gone to Scotland to deliver a series of lectures on geology before Edinburgh University.

SIR E. RAY LANKESTER will deliver the Huxley lecture for the present session at Birmingham University.

PROFESSOR WM. T. SEDGWICK, of the Massachusetts Institute of Technology, expects to leave Boston in the middle of April to make a number of addresses in the middle west.

AT the meeting of the Society of Arts of the Massachusetts Institute of Technology on March 25, President R. S. Woodward, of the Carnegie Institution, was expected to lecture on the work of the institution. On April 5 Professor George E. Hale, director of the Solar Observatory of the Carnegie Institution, is announced to lecture on "Solar Cyclones and Magnetic Fields."

DR. A. M. STEIN will give a lecture under the auspices of the Royal Asiatic Society on Tuesday, March 30, on his recent explorations in eastern Turkestan.

MR. D. CARRUTHERS, who took part in the British Museum expedition to Ruwenzori as a zoological collector under Mr. R. B. Woosnam in 1906, is at present exploring central Arabia.

DR. CHEVALIER, who since the conclusion of his expedition to the upper Shari basin, has been on the Guinea coast, has started on a new expedition to west Africa.

THE National Society of Acclimatization of France has conferred on Mr. W. Percival Westell its bronze medal in recognition of his natural history writings.

WILLIAM STUART, for the past ten years professor of horticulture in the Agricultural Department of the University of Vermont, has received an appointment in the plant bureau of the Department of Agriculture, Washington, and will enter upon his new duties at the close of the college year.

MRS. TYNDALL, in pursuance of the wishes of the late Professor Tyndall, who was a member of the Royal Commission appointed in 1879 to inquire into the causes of explosions in coal mines and who took a deep interest in problems concerning the safety of miners, proposes to found a gold medal to be awarded

annually for inventions tending to diminish danger and preserve life among those engaged in mining operations. The adjudication of this "Tyndall Medal" is to be placed in the hands of the managers of the Royal Institution, where Professor Tyndall occupied the chair of Natural Philosophy from 1853 to 1887.

IT is proposed to endow as a memorial to the late Dr. William T. Bull an institution for surgical research to be connected with the College of Physicians and Surgeons, Columbia University, from which Dr. Bull was graduated in 1872, and where he served for many years as professor of surgery. It is further stated that Mrs. Bull proposes to erect a memorial hospital for the treatment of tuberculosis.

PROFESSOR MARK VERNON SLINGERLAND, who held the chair of economic entomology at Cornell University, and was an authority on the injurious insects of the United States, died at Ithaca on March 10, at the age of forty-four years.

MAJOR EDMUND LEWIS ZALINSKI, U.S.N., retired, at one time professor of military science in the Massachusetts Institute of Technology, known for experimental work on high explosives, died in New York City on March 10, at the age of fifty-nine years.

DR. S. H. LAURIE, emeritus professor of education in the University of Edinburgh, died in Edinburgh on March 2 at the age of seventy-nine years.

DR. EMIL ERLENMEYER, formerly professor of chemistry in the Munich Technical Institute, has died at the age of eighty-three years.

THE deaths are also announced of M. Frédéric Rauh, professor of philosophy at Sorbonne, and Senhor Barbosa Rodrigues, author of several works on the Brazilian flora.

A RECENT list of the publications of the United States Geological Survey gives the titles of 977 volumes. This list does not include the separate chapters from the annual volume on mineral resources, which make up several hundred pamphlets.

IT is now finally settled that the Forest Service Experimental Laboratory will be situated at the University of Wisconsin. Opportunity was given to Michigan and Minnesota to present the advantages of those institutions, but the original plan will be carried out. Work on the new laboratory, which is to be located on Camp Randall near the agricultural buildings and the new site of the engineering group, will be begun at an early date. The university provides the site and a $30,000 building, while the forest service is to equip the laboratory at a cost of $14,000 and to provide the entire staff of investigators, whose salaries will aggregate $28,000 a year. The laboratory is to be available for students and faculty of the university for research work, and the members of the staff are to deliver lectures on forestry and allied subjects to students of the university. A course for forest rangers is to be provided by the university in connection with the experiment station as soon as it is completed. The work of the laboratory is to include tests of various kinds of wood for paper pulp, for building material, for the distillation of turpentine, alcohol and resin from wood waste.

APPROPRIATIONS FOR THE UNITED STATES BUREAU OF EDUCATION

THE estimates of appropriations for the United States Bureau of Education for the fiscal year ending June 30, 1910, as transmitted to Congress, included under the general head of salaries estimates for additional employees as follows: Expert in higher education, $4,000; expert in industrial education, $3,000; expert in the welfare of children, $3,000; editor, $2,000; additional clerks, $12,100. Of the new employees requested, Congress made provision for an editor at $2,000; one clerk at $1,200; and one clerk at $1,000. The salary of the Commissioner of Education was increased from $4,500 to $5,000, making a total increase in the appropriations for the general work of the Bureau of $4,700 over the appropriations for the current fiscal year. The requests for a lump sum appropriation of $40,000 for educational investigations; for an increase of $1,500 in the appropriation for the library; for an increase of $8,000 in the fund for collecting statistics; and of an ap-

propriation of $39,000 for rent, metal shelving, additional furniture, and removal of the Bureau to new quarters, did not receive the favorable consideration of Congress.

The appropriation for the education of the natives of Alaska remains the same as for the present year, $200,000. The appropriation for reindeer in Alaska was reduced, on the recommendation of the Commissioner of Education, from $15,000 to $12,000. Provision was made by Congress for the designation of employees of the Alaska School service as special peace officers to assist in the enforcement of law in Alaska.

UNIVERSITY AND EDUCATIONAL NEWS

Gifts amounting to $176,960 from Mr. John D. Rockefeller to the University of Chicago were announced on March 16 by President Judson at the recent convocation. The larger part is for the College of Education.

The New York *Evening Post* states that the University of Missouri will receive $500,000, for the assistance of needy students, by the will of Charles R. Gregory, of St. Louis, who recently died in Paris.

The Weyerhauser interests of St. Paul have given to the University of Minnesota 2,200 acres of land in Carlton County for the use of experiments by the forestry department.

In accordance with the terms of the will of the late Dr. Julian Hunter that the name of his father—Joseph Hunter—should be perpetuated in connection with his bequest to Sheffield University, the council has resolved to call the chair of pathology in the university the "Joseph Hunter Chair of Pathology." It is proposed with the Hunter bequest (amounting to £15,000) to establish a chair of economics and to carry on the department of philosophy and logic under a lecturer.

The Goldsmiths' Company will renew for a further period of three years their annual grant of £5,000 towards the maintenance of Goldsmiths' College, New-cross.

Mr. R. O. King, a former graduate of the faculty of applied science and a demonstrator in physics at McGill University, has established a fellowship in physics of the value of $600.

Efforts are being made to collect $500,000 to establish a medical school at Pekin.

It is reported in the daily papers that thirteen college presidents, whose institutions are among those classed as denominational, have presented a memorial to Dr. Henry S. Pritchett, president of the Carnegie Foundation. The memorial urges that many colleges which were founded by religious bodies are to-day free to men of all creeds and do not teach particular dogmas or require any particular beliefs by students or professors. They are, therefore, it is declared, practically nonsectarian.

Mr. George R. Parkin has sent a letter to members of the American Committees of selection for the Rhodes Scholarships at Oxford, stating that the trustees of the trust have decided that any candidate from the United States who has passed the qualifying examination in Latin and mathematics shall be eligible, even though he may not have passed in Greek. He will, however, be required to pass the examination in Greek before going into residence or at all events before receiving a degree.

The American Ethical Union will hold its summer school at the University of Wisconsin from June 28 to July 24, under the direction of Dr. Felix Adler, of Columbia University.

The inauguration of Professor A. Lawrence Lowell as president of Harvard University, will occur some time in October; the exact date has not been set.

The president's European fellowship of Bryn Mawr College has been awarded to Miss Grace Potter Reynolds, B.A. (Smith), M.A. (Columbia) and formerly assistant in chemistry at Barnard College, Columbia University.

At the School of Pharmacy of Western Reserve University, Professor W. H. Haake has resigned as professor of materia medica and is succeeded by Dr. Torald Sollmann.

Dr. David Fraser Harris has been appointed lecturer in physiology at Birmingham University to succeed Dr. Rhodes.

DISCUSSION AND CORRESPONDENCE

NOTE ON THE SPECTRUM OF MARS

I THINK that Professor Very's article on "The Presence of Water Vapor in the Atmosphere of Mars,"[1] though written with the kindliest feelings for all concerned, is certain to convey a wrong impression as to the observations made by Huggins, Vogel and others in the sixties and seventies and by myself in 1894–5. The pioneer observers believed they saw in the spectrum of Mars the modifying influences of oxygen and water vapor in its atmosphere. I held, and published, the opinion that "the polar caps on Mars are conclusive evidence of an atmosphere and aqueous vapor" on that planet;[2] but my spectroscopic observations, made under vastly improved conditions, convinced me that oxygen and water vapor did not exist in sufficient quantities to be detected by the spectroscopic method as then available, for this method is a very insensitive one. The observations by the earlier observers, and by myself, were confined to the spectral region λ5400 to λ6900. The region of wave-lengths *larger than* λ*6900* was entirely too faint for visual study, and in those days we had not the means of photographing it. About two years ago it was discovered that the application of certain chemicals to an ordinary dry-plate would make it quite sensitive to radiations of greater wave-lengths than λ6900. In the region thus rendered available, at λ7175, is the so-called little "*a*" band, due to water vapor. It is this band, in a region previously unobserved and unobservable in Mars' spectrum, upon which Professor Very's work is based exclusively. His investigations, therefore, afford no evidence as to the correctness of the early observations.

Now comes the point, omitted by Professor Very, which does bear upon the early observations. The spectrum photographs used by Very (made by Mr. Slipher at Flagstaff) recorded not only the new region containing the band "*a*," but also the old region λ5400 to λ6900. Mr. Slipher's published conclusion, as based on his series of seven spectrum photographs, is that "Aside from reinforcement of the '*a*' band (at λ7175), the spectrum of Mars shows no selective absorption not found in that of the moon photographed under the same conditions";[3] that is, *the effects of oxygen and water vapor on Mars were no more visible in the region* λ*5400*–λ*6900 of the spectrum than were the effects of oxygen and water vapor existing on the moon!*

Only those who have seen Mr. Slipher's original negatives can judge of their value; but whatever their value, they are absolutely confirmatory of my visual observations of 1894, of my photographic observations of 1895, of Professor Keeler's photographic observations of 1897; and as absolutely opposed to the observations of Huggins, Vogel, Maunder and others as my own observations were. Readers of Very's article would get exactly the opposite view.

If Mr. Slipher, observing from a high altitude and with little water vapor in our atmosphere to embarrass him, could see no difference between the spectra of Mars and the moon in the region λ5400–λ6900, how impotent were the effects of the pioneer observers at sea-level, with small telescopes, looking through ten times as much water vapor as Mr. Slipher and I did; yet, all hail, and nearly all the credit to the pioneers! Their work, though unsuccessful, makes progress possible by succeeding generations of investigators.

W. W. CAMPBELL

MT. HAMILTON,
February 6, 1909

[1] SCIENCE, January 29, 1909, p. 191.

[2] *Astronomy and Astrophysics*, 1894, p. 760.

A NEW KIND OF PTARMIGAN

TO THE EDITOR OF SCIENCE: The current *McClure's Magazine* (March, 1909) contains a sonnet which I am sure will entertain the readers of SCIENCE, even though it bears the gruesome title "The Shipwrecked Sailor." It contains this striking (in more senses than one) bit of ornithological news:

Yet he smiled,
Abandoning hope and drowning unaware,

[3] *Astrophysical Journal*, 28, p. 403, 1908.

Till a great sea-bird, tern or ptarmigan,
Caught by the whiteness of his lonely face,
Swooped low exultantly; huge swish of wings
Measuring his body, as he struck him once.
Thud of the ribbed beak, like a call to arms
Stirring the wounded soldier, etc."

What would not Mr. Chapman give for a moving picture of the author's mental image of a ptarmigan? Would it be in order, since Miss Florence Wilkinson is the writer to whom we are indebted for a description of this new species, to call the Ribbed-beaked Ptarmigan, *Lagopus wilkinsoni*?

HUBERT LYMAN CLARK

SCIENCE AND POLITICS IN CUBA

TO THE EDITOR OF SCIENCE: I have just learned that the new Cuban administration has asked for the resignation of all the Americans on the staff of the Cuban Agricultural Experiment Station. This is purely a political move made to supply more places for the horde of hungry office seekers. No comment is needed when a government is willing to make a political football of its only efficient scientific institution. The following is a list of those who have been so suddenly and unjustly deprived of their positions. I know all of these gentlemen personally and am familiar with their work. Many of them are former colleagues. I take a great pleasure in heartily recommending them to any institutions who may have vacancies in these respective lines.

Dr. N. S. Mayo, Chief, Department of Animal Industry.

Mr. J. S. Montgomery, Assistant, Department of Animal Industry.

Professor Wm. T. Horne, Chief, Department of Vegetable Pathology and Entomology.

Mr. J. S. Houser, Assistant, Department of Vegetable Pathology and Entomology.

Professor R. S. Stark, Chief, Department of Chemistry.

Dr. H. Hasselbring, Chief, Department of Botany.

Professor C. F. Austin, Chief, Department of Horticulture.

Mr. C. F. Kinman, Assistant, Department of Horticulture.

F. S. EARLE

SCIENTIFIC BOOKS

Laboratory Notes on Industrial Water Analysis. A Survey Course for Engineers. By ELLEN H. RICHARDS, Instructor in Sanitary Chemistry, Massachusetts Institute of Technology. 8vo, pp. iii + 49. Cloth, 50 cents net (2s. net). New York, John Wiley & Sons; London, Chapman & Hall, Limited. 1908.

The book is written for the use of students of engineering and deals with "boiler waters" principally.

Part I. is divided into five laboratory exercises: First, Classification of a Water as "Scale-forming," "Moderately Scale-forming," or "Corrosive"; second, Determination of "Total Solids," "Incrustants," "Iron" and "Sulphates"; third, "Alkalinity," "Magnesium as Hydrate" and "Permanent Hardness"; fourth, "Action Upon Metals," "Oxygen Consumed" and "Dissolved Oxygen"; fifth, "Remedies for Defects Found in Waters." "Only special methods are considered, leaving out the ordinary analytical processes to be found in text-books."

Part II. is devoted to the preparation of "standard solutions" and to sundry tables useful in water analysis.

The following sentence is well worthy of attention, as it points to a fact often lost sight of: "Water unsatisfactory for one purpose may be, or may be made, quite satisfactory for another."

Mrs. Richards has had such extended experience in matters dealing with water examination that anything from her pen is always of value.

W. P. MASON

A Laboratory Guide for Histology. By IRVING HARDESTY, A.B., Ph.D., with a chapter on Laboratory Drawing, by ADELEBERT WATTS LEE, M.D. With 80 illustrations, 2 of which are in colors. Pp. 193. Philadelphia, P. Blakiston's Son & Co. 1908.

That there is a place for such a well-planned, practical series of laboratory outlines for the study of histology and microscopic anatomy as are found in this guide the reviewer has no

doubt. The volume is a timely contribution and is characterized by all the excellencies which one is led to expect from a knowledge of the other publications of this careful and experienced teacher. Pedagogically considered, aside from its lopping off of superfluities, its greatest virtue lies in the manner in which the student is impelled to get at the subject interpretatively instead of blindly following descriptions. The method is not wholly inductive, however, since the student is expected to know what is said in his text-book or lectures on a given subject; nevertheless, through a judicious use of questions he is forced to think for himself and not simply to verify statements.

One great aim of the author has been to do away with the numerous irrelevant procedures at which the student is likely to fritter away his time and to lead him at once to see and to accomplish the real work that is to be done. The main idea has been to have him so utilize his time as to cover thoroughly the greatest possible amount of ground in the time allotted to the course. The outlines are the outgrowth of the author's own experience as a teacher and having been revised and corrected year after year, in their final form they represent, therefore, just what in his experience may most advantageously be undertaken by the average class in histology working three three-hour periods per week throughout one school year.

In case a school can not give three afternoons a week to the course, however, the work is so arranged that it can be given conveniently in two separate years. The reviewer is of the opinion, indeed, that the third section might well be reserved for the second year as it in itself constitutes a complete course in the gross and microscopic anatomy of the central nervous system and the organs of special sense, and includes work of considerably greater difficulty than that of the other two sections.

The author rightfully insists throughout the work upon the importance of having the transition from the macroscopic to the microscopic detail made with sufficient fulness for the student to get a complete mental picture of the structure as a whole instead of the mere fragments he too often gets when stained and sectioned material chiefly is used.

The arrangement of topics and the classification of structures is made mainly upon an anatomical and functional rather than an embryological basis. The practical utility of such an arrangement would seem sufficient to justify it even though an embryological arrangement would leave the student with a clearer morphological perspective of the general field. For the medical student, at least, the imperative demand is for the functional rather than the morphological conception. The embryological side, however, has not been slighted, for the principles and processes of development are kept well in the foreground and there are frequent demands for the study of sections of embryos and preparations of developing tissues and organs.

A valuable chapter is that by Dr. A. W. Lee on Laboratory Drawing in which a very enlightening discussion of drawing materials and methods is given. As Dr. Lee himself expresses it, "The individual who 'can't draw' has constantly been kept in mind; in fact, this chapter was undertaken solely for his benefit." Such a clear and non-technical discussion of laboratory drawing has long been a desideratum and it should not be reserved for those who study histology merely but should be brought to the attention of all biological students. Original drawings in varying stages of completion are employed as an aid in illustrating more graphically the principles involved. Unfortunately, by what is clearly a typographer's error, the block for figure 13 has been rotated ninety degrees with the result that the parallel which the author intended to show between this and the preceding figure is somewhat obscured.

A few of the seemingly inevitable typographical errors have crept into the volume here and there, but none is of great magnitude. Some of the most noticeable are as follows: page 40, formation for information; page 45, aquamous for squamous; page 54, glyerin for glycerin; page 72, cosmic for osmic, and the same on page 73; page 73, nonmodullated for non-medullated; page 139,

Ralando for Rolando, and page 180 in the last line *of* has been omitted.

An important adjunct to the work is the well-chosen list of original papers which is given at the end of the outline for each general subject. While not intended to be exhaustive it is thoroughly representative and includes all that the student could possibly utilize to advantage at this stage of his development.

The volume as a whole is a meritorious contribution from a skillful teacher and is a welcome addition to the histological laboratory.

MICHAEL F. GUYER

The Fauna of Mayfield's Cave. By ARTHUR M. BANTA. Pp. 114, with plates, map of the cave, figures and tables. Published by the Carnegie Institution, Washington, D. C., September, 1907.

Mayfield's Cave is in Monroe County, Indiana, 4.5 miles northwest of Bloomington, the location of the Indiana University. It has often been visited, and its contents have been described in part by Bollman, Hay, Blatchley, Call, Eigenmann and others. What has been admirably done by Arthur M. Banta is to visit it on an average once a week during eight months in all, covering different seasons of the years, 1903, 1904 and 1905, using the strong, steady light of a carbide bicycle lamp, observing all phenomena, noting the temperature and air currents, and in particular collecting all varieties of animal life for detailed study with the facilities afforded by the laboratory of the university and the expert aid of C. H. Eigenmann. Contours for the cave map are by J. W. Beede, and the photographs are by E. R. Cummings. Full recognition of work done by others is made in the introduction, and in a bibliography mentioning more than 130 works and papers consulted.

Mayfield's Cave is only a fourth of a mile long, is from 6 to 20 feet wide, and is nowhere more than 12 feet high, while many passages are mere crawl-ways. The roof is usually flat and hard limestone, with small domes here and there. The floor is strewn with large and small fragments of stone, with patches of gravel or soil, and occasional banks and mounds of earth. The excavation is in the Mitchell limestone of the upper Subcarboniferous. The entrance is in a low bluff at the head of a ravine once a part of the cave. There are sink-holes without and springs within, and in winter and spring a cave stream flows through, which ceases to flow in summer, leaving detached pools, parts of the channel remaining moist and other parts being quite dry. The temperature of the earth tends to counteract that of the air currents from without, bringing the average to about 11.9° C., equalling the mean temperature of the region.

Cavern fauna depend on an irregular food-supply and lead a precarious life. Flowing water brings in algæ, worms, insects, seeds and other material; mammals and human visitors leave various reminders; and fungus grows abundantly on decaying organic matter. Dry parts were poor collecting ground, while better results were had in moist localities. Most cave animals are scavengers. Some are strays, or accidental visitors; others visit voluntarily; while true cavernicola are classified as temporary, permanent and exclusive residents—the latter never found elsewhere. Banta also classifies them in their relation to daylight, twilight and darkness.

Sixty-six pages are devoted to detailed scientific descriptions of the fauna of Mayfield's Cave, under the heads of Mammalia, Pisces, Insecta, Myriopoda, Arachnida, Crustacea, Annelida, Mollusca and Turbellaria. Six pages are filled by comparative tables of species known to exist in Indiana caves as compared with those found in this single cave; the sum total being 138 species, 110 of which exist in Mayfield's Cave. This is certainly remarkable.

Of true cave fauna the most space is allotted to the blind fish (*Amblyopsis spelæus*, DeKay) concerning which curious experiments were made as to its habits, anatomy and its food as determined by inspecting the contents of the stomach. Two varieties of cave crawfish were found (*Cambarus pellucidus*, Packard, and *Cambarus pellucidus testii*, Hay); the distinction being the presence or the absence of spines. To the cave-

hunter these and other descriptions of strange and unusual forms of life are fascinating.

Several pages are occupied by general observations, with an interesting discussion of the origin of cave life. The latter is treated under three questions: (1) How did these animals get into the caves? (2) What was their condition when they entered? (3) How have they reached their present state? Answering these inquiries the author argues that cave animals originated from outside forms, being predetermined to such cave conditions as suited them; that, at first, they differed slightly from similar forms, but were better adapted than they for subterraneous existence; and that they reached their present condition by gradual adjustment to environment, modified by cumulative variations due to heredity.

Taking the monograph as a whole, Mr. Banta is to be congratulated on having given a most commendable example of what can be done by an exhaustive study of a small cavern, and on having thus made a valuable contribution to scientific literature.

Horace C. Hovey

SCIENTIFIC JOURNALS AND ARTICLES

Terrestrial Magnetism and Atmospheric Electricity for March contains the following articles: "L'Observatoire Magnétique de Zika-wei," by J. de Moidrey; "Carnegie Institution Comparisons of Magnetic Standards during 1908," by J. A. Fleming and J. C. Pearson; "The Carnegie Institution Marine Collimating Compass," by W. J. Peters; "Some Problems in Radioactivity," by A. S. Eve; "Peculiar Magnetic Disturbances in December, 1908," by D. L. Hazard.

The American Naturalist for March contains the papers read at the Darwin Memorial Session of the Baltimore meeting of the Botanical Society of America, held December 29. These papers are: "Darwin as a Naturalist: Darwin's Work on Cross Pollination in Plants," by William Trelease; "Darwin's Influence upon Plant Geography and Ecology," by Frederic C. Clements, and "Darwin's Work on Movement in Plants," by Herbert Maule Richards. In addition there is "An Examination of Darwin's 'Origin of Species' in the Light of Recent Observations and Experiments," by Edwin Linton. Edward M. East discusses "The Distinction Between Development and Heredity in Inbreeding," and T. H. Morgan describes some results of "Breeding Experiments with Rats," the species being *Mus rattus*, *M. alexandrinus* and *M. decumanus*. Among the "Shorter Articles" is a note by Roy L. Moodie, stating that in parts of the Niobrara River the chub, *Semotilus*, has acquired the habit of feeding on the horn fly that infests cattle, follows up the cattle and captures flies by jumping and picking them from the animal's sides.

Bird-Lore for January-February contains articles on "The Hollow Tree," by Ernest T. Seton; "The Feud of the Crows and the Owl," by Frank M. Chapman; "Birds seen in Prospect Park, Brooklyn," by Kate P. and E. W. Victor; "Notes on Pacific Coast Shore Birds," by John T. Nichols, and the eighth and last paper on "The Migration of Flycatchers," by W. W. Cooke. The Ninth Christmas Bird Census gives the results of observations from a large number of localities and the "Report of Audubon Societies" records the painful fact that two Audubon wardens have been brutally murdered. This illustrates the character of some of the men engaged in "the feather business." It used to be said that each elephant tusk cost the lives of three men and we await statistics on aigrettes.

In the *American Museum Journal* for February Roy C. Andrews describes "A Summer with the Pacific Coast Whales," illustrated with some remarkable views from life. E. O. Hovey tells of "St. Pierre and Mt. Pelé in 1908," giving some illustrations showing how rapidly vegetation is springing up over the region devastated by the eruption of 1902. New exhibits have been arranged illustrating the industries of the California Indians, and it is noted that the museum has acquired the Waters collection of Fiji objects.

On February 28 a Brazilian tapir was born at the National Zoological Park, Washington, D. C., making the fifth of this species that

has been born there. The period of gestation was 401 days; in another instance it was 395 days. The little tapirs have been strong and were raised with comparatively little trouble.

NOTES ON ENTOMOLOGY

THREE more volumes have been issued by the Indian government in the series "The Fauna of British India." Two are on the Coleoptera. Volume I. is on the Cerambycidæ, by C. J. Gaham (329 pp., 107 figs.), and deals with nearly one half of the longicorn beetles of India. They are arranged in four subfamilies—Cerambycinæ, Lepturinæ, Disteniinæ and Prioninæ. Nearly 400 species are described. Vol. II. (Coleoptera), on the Chrysomelidæ, is by the late Martin Jacoby (534 pp., 172 figs., 2 colored plates). He arranges the forms in five divisions: Eupodes, Cyclica, Camplosomes, Trichostomes and Cryptostomes. The species of the last two divisions are not treated in this volume; the Trichostomes include the Halticinæ and the Galerucinæ. Over 900 species are described, many of which are new. Volume IV. of the Rhynchota (Homoptera and appendix, 501 pp., 282 figs.) is by Dr. Distant. It contains the families Membracidæ, Cercopidæ and Jassidæ; the appendix is mostly on the Pentatomidæ. In this volume 665 species are described, bringing the total number of Hemiptera described from India up to 2,768.

MR. EDWARD CONNOLD has published on the British oak galls a companion volume to his work on British vegetable galls.[1] There are chapters on the growth of galls, characters and habits of the Cynipidæ, the British oak, and collecting and mounting oak galls. There is, under each species, a succinct statement comprising the English name of the gall, the position of the gall, the manner of growth, color, size, time of year, whether with one or many larvæ, where larva pupates, time of issuance of fly and parasites and inquilines. The insects are not described. Fifty-four galls of Cynipidæ are treated, and two of other insects. The plates are photographs of the various galls, often showing much variation in shape.

MR. R. E. TURNER has completed a revision of the Australian species of a peculiar family of Hymenoptera, the Thynnidæ.[2] This family is extremely abundant in Australia, about 400 species being known, over 120 of which are described as new by Mr. Turner. Very little is as yet known of their life history; a few bred from underground pupæ of Lepidoptera or Hymenoptera. The author severely criticizes the classification of Ashmead, but adopts most of the genera of Guèrin and Westwood. The characters at present used for the genera are found mostly in the sexual organs; a better classification must await the discovery of characters associating the sexes. Mr. Turner excludes from this family the genus *Anthobosca,* which he considers more related to *Myzine.* With the exception of the genus *Ælurus* the South American Thynnidæ are of different genera than the Australian.

PROFESSOR WHEELER has written a most interesting comparative study of the ants of Europe and North America.[3] He shows that there are fully twice as many kinds of ants in the United States as in Europe. In both countries the ant-fauna is composed of two elements, the boreal and the tropical. The former is very similar in the two regions, but the latter is very divergent, owing to different origins. The difference in nidification of similar ants in Europe and North America is considered due to the amount of sunshine; and it is shown that nests are more abundant in the interior of our country than in the eastern states. There is a summary of the fossil ants of the two countries; a chapter on the parasitic ants of Europe and on the myrmecophilous insects.

MR. W. SCHULTZE has an interesting article on the young of certain leaf-beetles of the

[1] "British Oak Galls," London (Adlard & Son), pp. 170, 68 plates, 1908.

[2] "A Revision of the Thynnidæ of Australia," *Proc. Linn. Soc. N. S. Wales*, XXXII., pp. 206–290, 1907; XXXIII., pp. 70–256, 1908.

[3] "Comparative Ethology of the European and North American Ants," *Journal f. Psychologie u. Neurologie*, XIII., pp. 404–435, 1908, 2 double plates.

family Cassididæ.[4] Many larvæ of these beetles have peculiar lateral expansions of the body, and a long spiny or bristly tail, which accumulates excrement and cast-skins, and is recurved over the body. When disturbed the larvæ erect and wave these tails. He concludes that these structures are used principally as a protection against parasitic enemies. The eggs are enclosed in a case, frequently one in each case, and these cases are often covered with excrement.

Mr. H. S. Smith has published a most useful work on the Hymenoptera of Nebraska,[5] a synoptic and descriptive catalogue of the Sphegoidea of that state. There are tables to the genera and species, and descriptions of fifteen new forms; altogether over 200 species are recorded from the state. It is hoped that some eastern hymenopterists will follow the example.

Professor E. B. Poulton has published a detailed museum study of our butterflies of the genus *Limenitis*,[6] tending to show the influence of *Anosia plexippus* and *Danaida berenice* upon *L. archippus*, and its varieties. He also considers that *L. californica* is the model of *L. lorquini*. Although he brings out many interesting points about coloration and pattern, one can not fail to notice the paucity of field observations which alone are of determining importance in these matters. The author considers that *Papilio philenor* is mimicked by three other species of the genus —*P. troilus*, *P. asterius* (female) and *P. glaucus* (female), which would hardly be suspected by any one familiar with these butterflies in the field.

Mr. W. Lundbeck has published the second part of his book on Danish diptera.[7] As with the preceding part, this is a most excellent treatment of the subject. The structural characters are given in great detail; there is a good account of habits and life-history; and under the Asilidæ are numerous records of their prey, showing that there is no mimicry of their prey by these ferocious flies. Although the species known from Denmark are very few, the author's treatment of the genera and families is so full as to make the work a most useful one to the American dipterist.

Attention should also be called to the recent catalogue of Argentine Diptera by Dr. J. Brèthes.[8] He lists the flies of Argentina, Patagonia, Uruguay and Paraguay, 650 species in all; mostly in the Asilidæ and Syrphidæ. There are 23 species of mosquitoes.

Nathan Banks

[4] "Life Histories of some Philippine Cassididæ," *Phil. Journ. Sci.*, III., pp. 261–271, 6 pls. 1908.

[5] "The Sphegoidea of Nebraska," *Univ. Studies*, Vol. VIII., No. 4, October, 1908, pp. 88, 1 plate.

[6] "Mimetic North American Species of the Genus *Limenitis* and their Models," *Trans. Ent. Soc. Lond.*, 1908, pp. 447–488, 1 plate.

[7] "Diptera Danica; Genera and Species of Flies Hitherto Found in Denmark." Part II., Asilidæ, Bombylidæ, Therevidæ, Scenopinidæ. Copenhagen, 1908, pp. 162, 48 figs.

[8] "Catalogo de los Dipteros de las Republicas del Plata," *Anales Mus. Nac. Buenos Aires* (3), IX., pp. 277–305, 1908.

SPECIAL ARTICLES

CONCERNING THE EXISTENCE OF NON-NITRIFYING SOILS

It is believed by agricultural specialists as well as by bacteriologists that soils generally have the power to convert organic or ammoniacal nitrogen into nitrate nitrogen, *i. e.*, to nitrify. Nitrifying organisms are supposed to abound to such an extent that any stratum not possessing them would soon become inoculated with them by air, soil, manure, water or other means.[1]

Filter beds, originally non-nitrifying, soon become vigorous nitrifiers without inoculation; sewage nitrifies freely in running streams; nitrate as saltpeter is of almost universal natural occurrence. A surface soil which can not nitrify would be regarded as a rare anomaly, therefore, and that many such non-nitrifying soils exist, could not be expected from the generally assumed conditions.

During our work of the past few years, we have, however, been repeatedly confronted with the fact that many of our soils do not nitrify. The first evidence of the existence of non-

[1] Le Far, "Handbuch der Technischen Mykologie," III., 147.

nitrifying soils was afforded in 1903 during an attempt of one of us to demonstrate nitrification to a class in bacteriology after the usual laboratory manner.[2] The attempt resulted in a complete failure to secure nitrification. This observation was confirmed by the other at a later time while working independently with other soils. This is noted on page 14 of the report of the North Carolina Agricultural Experiment Station, 1906–7. Since that time, in connection with our studies in nitrification, many samples of soils have been tested for nitrifying power with the result that a large majority of the soils of this region are found to be devoid of this power. The numbers of the soils tested, dates, mode of test, whether in soil or in solution, and the results, are given in the following table.

The tests in solutions were made by the usual method of placing from 0.2 g. (Ashby's Method) to 5 or 10 g. of the soil to be tested into an ammoniacal solution such as that of Omelianski, Wiley or Ashby.

Tests in soil were made by adding nitrogenous material, organic or ammoniacal, to the live soil or by sterilizing the soil, adding the nitrogen, then inoculating with a suspension of the soil to be tested, incubating, shaking with water, filtering, clarifying and analyzing.

Soils which are reported here as negative did not give enough nitrate or nitrite to respond to the diphenylamine test.

SAMPLES OF LOCAL SOILS

29 per cent. nitrifiers.
71 per cent. non-nitrifiers.

LOCAL SOILS

37 per cent. nitrifiers.
63 per cent. non-nitrifiers.

It is seen that of the 62 local samples tested in soil culture, 44, or 71 per cent., failed to nitrify, 18, or only 29 per cent., nitrified; of the 40 different local soils tested 15, or 37 per cent., nitrified while 25, or 63 per cent., failed to nitrify, even though soils which sometimes nitrified slightly and sometimes failed, as Nos. 1783 and 1746, are recorded for this purpose as nitrifying soils.

[2] Buxton, B. H., *Jour. Ap. Mic.*, 5, p. 1975.

Soil	Date of Sampling	Results in:	
		Soil	Solution
1830	October 3, 1905	0	
1855	November 21, 1905	0	
1830	December 5, 1905	0	
1830	February 7, 1906	0	
Plat 12	February 26, 1906	0	
1540	September 17, 1906	0	
1540	October, 1906	0	+
1540	August 10, 1908	0	
1549	September 17, 1906	0	
1549	August 10, 1908	0	0
1667	October 31, 1907	0	0
1667	April 23, 1908	0	0
1667	August 6, 1908	0	0
1746	September 17, 1906	0	
1746	October, 1906	+	+
1746	August 10, 1908	0	0
1783	September 17, 1906	0	
1783	October, 1906	+	+
1783	August 13, 1908	0	0
1784	September 17, 1906	+	
1784	August 13, 1908	0	0
1859	November, 1906	0	
1860	November, 1906	0	
1861	November, 1906	+	
1862	November, 1906	0	
1863	November, 1906	0	
1864	November, 1906	0	
1865	November, 1906	0	
1866	January 23, 1907	+	0
1866	October 21, 1907	+	0
1867[3]	February 1, 1907	+	0
1867	October 31, 1907	+	+
1867	August 12, 1908	+	
1870	February 13, 1908	+	
1871	February 18, 1908	+	
1931	November 9, 1907	0	
1931	January 10, 1908	0	
1931	August 13, 1908	0	+
2069	February 11, 1908	+	0
2526	August 17, 1908	0	0
2527	August 17, 1908	0	0
2528	August 17, 1908	0	0
2529	August 20, 1908	0	+
2530	August 20, 1908	0	0
2531	August 20, 1908	0	+
2559	September 17, 1908	0	+
2559	October 15, 1908	0	
2560	September 17, 1908	0	+
2560	October 15, 1908	0	+
Plat 1	December, 1906	0	
" 2	December 13, 1906	0	
" 6	September 29, 1906	+	
" 7	October 29, 1906	0	
" 7	December, 1906	+	
" 9	October 10, 1906	+	
" 10	October 29, 1906	0	
" 10	October 31, 1907	0	0
" 12	September 10, 1906	+	
" 12	December, 1906	0	
" 13	September 29, 1906	0	
" 17	November 8, 1906	+	
" 17	December, 1906	+	

[3] Tested at least twelve times and never failed to nitrify but once.

These soils, with the exception of Nos. 1866, 1867, 1870 and 1871, are normal agricultural soils mostly from within a mile of the farm of the North Carolina Agricultural Experiment Station and are normally productive though not to be classed as rich soils. Nos. 1866 and 1867 are soils from the college green house. Nos. 1870 and 1871 are from commercial green houses of Raleigh.

For comparison, samples of soil were secured from New Jersey through Jacob Lipman, Washington, D. C., from Karl Kellerman, Michigan from W. S. Sayer and Wisconsin from H. L. Russell. It was requested that soils most promising as to nitrifying power be sent. It is seen from the following table that positive results were secured with each of these soils.

Soil	Date of Sampling	Results in:	
		Soil	Solutions
N. J. (H.)	September 28, 1908	+	+
N. J. (R. S.)	September 28, 1908	+	+
D. C. soil	September 28, 1908	+	+
Mich.	October 1, 1908	+	+
Wis.	October 1, 1908	+	+

The positive response of all of these soils and of our own green-house soil serves to doubly emphasize the fact that many of the soils here reported are really lacking in nitrifying power.

Further study of the quantitative results would emphasize still more the differences, since in many instances the soils which we have reported positively gave only a trifling amount of nitrate as compared with soils which are in vigorous nitrifying condition, *i. e.*, most of the soils which we report here as nitrifiers are, with the exception of Nos. 1866 and 1867, very poor nitrifiers as compared with 1866 or with the soils sent to us from distant sources.

While these data include various soils at various times of the year and under diverse climatic conditions, it is, of course, possible that some of the soils here recorded as non-nitrifiers would have induced nitrification if tested at some other time of the year; indeed there is positive evidence that in some instances soils change to a very marked extent in nitrifying power, but inasmuch as the tests here reported cover, in many instances, the period of crop production, their agricultural bearing would not be materially altered.

It is obvious that the absence of nitrifying power is a bacteriological condition that must be reckoned with in soil study. Upon its significance we are by no means ready to pronounce.

F. L. STEVENS,
W. A. WITHERS
NORTH CAROLINA AGRICULTURAL
EXPERIMENT STATION,
WEST RALEIGH, N. C.,
December 8, 1908

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ANTHROPOLOGY AT THE BALTIMORE MEETING

THE joint meeting of Section H of the American Association and the American Folk-Lore Society was held at the Maryland Institute, Baltimore, December 28–31, 1908.

MEETINGS OF THE SECTIONAL COMMITTEE

In the absence of Professor R. S. Woodworth, vice-president of the section, Professor Boas, retiring vice-president, acted as chairman of the sectional committee. Officers of the Baltimore meeting were nominated as follows:

Member of the Council—B. T. B. Hyde.

Member of the General Committee—G. G. MacCurdy.

Sectional offices were filled by the nomination of Professor William H. Holmes, Washington, D. C., as vice-president for the ensuing year; Dr. George Grant MacCurdy, New Haven, Conn., secretary for five years; and Dr. Geo. A. Dorsey, member of the sectional committee, to serve five years. These candidates were later elected by the association in general committee. Professor W. H. Holmes was also elected president and Dr. George Grant MacCurdy reelected secretary of the American Anthropological Association, the proceedings of which are printed in the *American Anthropologist* for January–March, 1909.

ADDRESSES AND PAPERS

The address of the retiring vice-president, Professor Franz Boas, was on "Race Problems in America." "The Mythology of the Central and

Eastern Algonkins" was the subject of Professor Roland B. Dixon's presidential address before the American Folk-Lore Society. It will be printed in the first number of the *Folk-Lore Journal* for the current year.

The reports of several standing committees of the American Anthropological Association were of such general interest as to be in the nature of papers. That of the committee on archeological nomenclature, Dr. Charles Peabody, chairman, was ordered to be printed in full as a report of progress, as follows:

The following report has been prepared by Professor John H. Wright, Mr. J. D. McGuire, Mr. F. W. Hodge, Mr. W. K. Moorehead and Dr. C. Peabody, chairman. The recent illness and death of Professor Wright deprived the committee of his advice and suggestion during the final drafting; with this exception the report is unanimous.

To the President and Members of the American Anthropological Association:

The committee on nomenclature of specimens has the honor of submitting the following report; it covers only certain divisions of objects in clay and of objects in stone; the departments referred to seem to the committee to be peculiarly suited to a rigid examination resulting in definition, classification and naming.

In all the object of the committee has been to reduce everything to its lowest terms, to use English words, if possible, and words that shall be perfectly clear in denotation to scholars at home and abroad, and to adhere as closely as may be to classifications already made standard.

As has been well said, the difficulty in classification and nomenclature comes from our lack of complete and detailed knowledge.

The classifications here offered and the definitions here proposed in some detail are based, so far as is possible, on form alone. It is, of course, taken as an axiom that a classification based on form assumes no theory of the development, interrelation or conventionalization of forms or types in any manner whatsoever; it has been the particular aim of the committee to avoid or get rid of those classes and names that are based on uses assumed but not universally proved for certain specimens.

Should the attempt meet with the favor of the members of the association, it should be possible at a future date to apply the same principles to a detailed examination of other stone specimens and to specimens in shell, basketry and textiles, so far as has not been already done.

ARTICLES IN CLAY

Simple vessels in clay may be presumed to cover all forms except eccentric or conventionalized (*i. e.*, animal-shaped) forms, on the one hand, and discs and pipes on the other.

It is suggested by the committee that members of the American Anthropological Association having occasion to describe clay vessels may classify them: first, as to material, as consisting of clay, sand, shell and their combinations, and as possessing certain general ground-color; second, as to manufacture, as sun-dried or fired, as coiled or modeled—with the variations and steps of each process; third, as to form; fourth, as to decoration, as plain, stamped, incised or painted. With regard to form the committee begs to offer the following definitions and suggestions in classifications.

In all cases measurements are considered as referring to an upward direction.

A simple vessel must consist of a body and may have a rim, neck, foot, handle or any combination.

(1) Body: A formation capable of holding within itself a liquid or a solid substance.

(2) Rim: (A) A part of the vessel forming the termination of the body. (B) A part of the vessel recognizable by a change in the thickness of the material in the terminal sections.

(3) Neck: A part of the vessel recognizable by a more or less sudden decrease in the rate of increase or decrease of the diameter.

(4) Foot: An attachment to the vessel which serves as the support to the body when upright.

(5) Handle: A part of the vessel consisting of some outside attachment, not serving as support.

Body.—It is suggested that in comparing the forms or cross-sections of vessels particular attention be paid to the proportion of the diameter to the height, to the rate of change of this proportion, to the place of change of direction in this proportion and to refer to the following definitions of the two dimensions:

Height: The distance from the base to a horizontal plane passing through the most distant part of the rim.

Diameter: The distance from any one point on the sides to any opposite point on the sides measured on a plane at right angles to the height.

Base: The point of contact or a plane of contact of the body with a horizontal surface.

Types: Body.—These are so various, depending on relative height and diameter of the cross-section, that an analysis is too cumbersome to be of service to general reference.

Neck.

1. Expanding.
2. Cylindrical.
3. Contracting.
4. Combinations.

Lip.—A part of the neck or body recognizable by a suddenly increasing diameter of neck or body, that continues increasing to the rim.

Foot.—1. Continuous.

(A) Expanding.
(B) Cylindrical.
(C) Contracting.
(D) Combinations.

Feet.—2. Not continuous.

Differentiated by
(A) Number.
(B) Angle with the horizontal.
(*a*) Expanding upward.
(*b*) Perpendicular.
(*c*) Contracting upward.

Handles.—Types.

Differentiated by
1. Number.
2. Position on the vessel.
(A) Body.
(B) Neck.
(C) Foot.
(D) Combinations.
3. Form.
(A) Continuous with body or neck.
(B) Not continuous with body or neck.
(*a*) With constant direction.
(*b*) With varying direction.
(*c*) With reentry upon vessel.
(A′) Round.
(B′) Flat.
(C′) Coiled.

ARTICLES IN STONE

Chipped Stone

I. Knives and projectile points.

Larger = 5 cm. (2 inches) or more in length.
Smaller = less than 5 cm. (2 inches) in length.

Types.

1. Without stem.
(A) Without secondary chipping (= flakes).
(B) With secondary chipping.
(*a*) Pointed.
(*a′*) At one end.
Base concave.
Base straight.
Base convex.
Sides convex.
One side convex.
One side straight.
(*b′*) At both ends.
(*b*) Ends convex.
(*c*) More or less circular.
2. With stem.
(A) Stem expanding from base—with or without barbing.
(*a*) Base concave.
(*b*) Base straight.
(*c*) Base convex.
(B) Stem with sides parallel—with or without barbing.
(*a*) Base concave.
(*b*) Base straight.
(*c*) Base convex.
(C) Stem contracting from base—with or without barbing.
(*a*) Base concave.
(*b*) Base straight.
(*c*) Base convex.

Note 1. The proportion of the length of the base to its breadth should be observed.

Note 2. The notches in barbed specimens may be vertical, horizontal or with varying diameter.

Note 3. The angles formed by the faces (*i. e.*, "bevel") should be observed.

II. Scrapers.

Types.

1. With one or more scraping edges.
2. Without or with notch (including circular).

III. Perforators.

Types.

Differentiated by
1. Cross-section.
(A) Round.
(B) Quadrangular or irregular.
2. Stem.
(A) Without stem.
(B) With stem.
(*a*) Stem expanding gradually.
(*b*) Stem expanding suddenly.

IV. Hammerstones.

Types.

1. Spheroidal.
2. Discoidal.
(A) "Pitted."
(B) Not "pitted."
3. Elongated.
(A) Grooved.
(B) Not grooved.

Note 1. Practical or ornamental serration may be applied to many forms.

Note 2. Combinations of the types may appear in one specimen and any type may be infinitely varied by individual caprice.

Ground Stone

I. [illegible]atical forms.

[illegible] (*i. e.*, flat "spuds," "gorgets" and [illegible]nts).

[illegible]

[illegible] Spade-shaped.

[illegible] Ovate.

[illegible] Sides concave (not common).

[illegible] Sides straight.

[illegible] Sides convex.

[illegible] Leaf-shaped.

[illegible] Spear-shaped.

[illegible] Rectangular.

[illegible] Sides concave.

[illegible] Sides straight.

(*c*) Sides convex.

[illegible]) Shield-shaped.

(G) Pendants.

(*a*) Celt-shaped.

(*b*) Rectangular.

(*c*) Oval or circular.

[illegible] Resemblances to known forms.

(A) Animal-shaped stones.

(B) Boat-shaped stones.

(C) Bar-shaped stones.

(*a*) Longer, resembling true "bars."

(*b*) Shorter, "ridged" or "expanded gorgets."

(D) Spool-shaped stones.

(E) Pick-shaped stones.

(F) Plummet-shaped stones.

(G) Geometrical forms.

(*a*) Spheres.

(*b*) Hemispheres.

(*c*) Crescents.

(*d*) Cones.

3. Perforated stones with wings.

(A) Wings with constant rate of change of width.

(*a*) Wings expanding from perforation.

(*b*) Wings with sides parallel.

(*c*) Wings contracting from perforation.

(B) Wings with varying rate of change of width.

II. Tubes and tube-shaped stones.

III. Beads.

IV. Pitted stones other than hammer-stones.

The committee finally takes pleasure in thanking the following members for assistance rendered:

Professor N. H. Winchell, University of Minnesota, Minneapolis; Professor Henry Montgomery, University of Toronto, Toronto; Professor Wm. N. Bates, University of Pennsylvania, Philadelphia; Dr. H. Kinner, St. Louis, Mo.; Dr. George Grant MacCurdy, Yale University, New Haven; Mr. W. Raymond Harrington, New York; Mrs. Zelia Nuttall, Coyoacan, D. F., Mexico; Mr. C. C. Willoughby, Harvard University, Cambridge; Dr. Walter Hough, National Museum, Washington; Dr. Nicholas León, Mexico; Mr. F. S. Dellenbaugh, New York; Professor F. W. Putnam, Harvard University, Cambridge; Dr. John M. Wulfing, St. Louis; Mr. H. I. Smith, American Museum of Natural History, New York; Rev. J. D. Marmor, New York; Mr. Christopher Wren, Plymouth, Pa.; Dr. A. W. Butler, Indianapolis; Dr. H. W. Shimer, Boston; Professor W. H. Holmes, Washington; Mr. Richard Herrmann, Dubuque, Iowa; Dr. H. F. ten Kate, Tokio; Dr. J. B. Ambrosetti, Buenos Aires.

The committee was continued and asked to collate the terminology already in use.

The report of the Committee on Concordance of American Mythologies was accepted as read by Professor Boas, chairman, and the committee was continued.

Mr. F. W. Hodge's report as chairman of the Committee on Linguistic Families North of Mexico was accepted and the committee continued. In this connection it was moved and carried that whenever an author uses a term not acceptable to the committee the editor be instructed to add in parenthesis the term approved by the committee. Mr. Hodge also reported for the Committee on Book Reviews, of which he is chairman. The report was accepted and the committee discharged at their own request and with a vote of thanks for their labors on the part of the association.

Dr. George A. Dorsey, recently returned from a year's stay in the far east, gave an interesting account of his journey through New Guinea. The Papuans of New Guinea are very different physically from the natives of New Britain. The various forms of head-dress were described; also the splendid character of the pile dwellings that are such a striking feature of the coast region. Mention was made of the wooden drums five to fifteen feet in length, great adzes of stone and shell, wooden bowls carved to represent animals, the canoes, etc. All are expert canoe men. The usual form is the outrigger carrying sails and often of great size.

The Big River (Kaiserin Auguste) was ascended for a distance of 110 miles, where it was still as large as and deeper than the Mississippi at St. Louis. The country is flat and covered by extensive forests. Twenty villages (sago gatherers)

were passed. The sago palm is cut down near the ground and the top lopped off; the trunk is split and the mass of sago broken up by means of a cylindrical stone set as an adz. The houses differ from those along the coast. They are built on piles, to be sure; instead of being squarish, they are long, narrow and absolutely open at each end. This is to provide ventilation, as the natives sleep in long mosquito-proof, tightly woven rattan bags. There is usually an altar with human images. Human skulls (of relatives) are placed on the floor in front of these altars. The canoes are carved at one end to represent the alligator.

"Geological Facts bearing on the Place of the Origin of the Human Race" was the title of a paper by Professor George Frederick Wright. It is becoming more and more clear that the glacial period was ushered in by a general land elevation over all the northern hemisphere (if not the whole world). All the high mountains of the world bear Tertiary strata at elevations of several thousand feet. The effect of such elevation would be to enlarge the continental area around all their borders and form land connection between northwestern America and northeastern Asia and possibly between Greenland and northern Europe. It would also connect North America with South America through the West Indies, and Europe with Africa across the Straits of Gibraltar and the shallow belt extending south from Sicily. That there was such a land connection appears from the fact that at the close of the Tertiary period, as the glacial epoch was approaching, there was a remarkable intermingling of the fauna of these connected regions. The elephant and rhinoceros came over from Africa and wandered as far north as Yorkshire, England. The megalonyx and some other South American species wandered into North America as far as Ohio, while the mammoth spread from central Asia across Siberia to northwestern America and wandered to the Atlantic coast and borders of Mexico.

Cumulative evidence seems to point to central Asia as the center from which man was dispersed in company with the mammoth over the entire northern hemisphere. Central Asia seems to have been the earliest center of civilization. Here in the ancient valley of the Oxus, according to Pompelly, there are ruins of cities which reach back to 8000 B.C., and here, beyond reasonable doubt, the Aryan family of languages had its origin.

A study of the physical changes which passed over this region contemporaneously with those in northern America and Europe during the glacial period and the now undoubted connection of man with the glacial period, render very plausible the hypothesis that the changes connected with that period were a contributory cause of the dispersion of mankind from this Asiatic center. Recent investigations show that, during the glacial period, central Asia offered a specially favorable area for the development of man together with both the vegetable and animal species upon which he is dependent for means of sustenance. The whole region is dependent upon irrigation, which is secured by the flow of water which comes down from the melting ice and snow on the lofty mountain heights. At the present time this irrigated belt is a very large one, but during the glacial period when the ice came several thousand feet lower down on the mountains (but never to the plains), the irrigated areas were immensely larger, furnishing sustenance for an indefinitely larger population. But at this time all northern Europe and northern America were enveloped in glacial ice. But as the glacial period declined the supply of water from the mountains of central Asia diminished and the oases contracted so as greatly to curtail the field of human occupation. Contemporaneously with this curtailment in central Asia the fertile plains of Europe and North America were opened to occupation by the melting of the ice, so that streams of emigration entered both Europe and North America from this common center. In America the Aryan-speaking races are just entering upon this glacial inheritance. It certainly means a great deal in the settlement of the question of the origin of the human race that we have so many classes of facts pointing to this conclusion or at least coinciding with this theory.

Professor Wright also presented for inspection three implements recently found, supposed to be of glacial age. The first was one already described by Miss Luella A. Owen in the sixth volume of "Records of the Past." The evidence is perfectly satisfactory that it was found in undisturbed loess at St. Joseph, Mo., thirty feet or more below the surface. The second was found in the bottom of a pit where the loess was being excavated two or three miles above St. Joseph, and in all probability came from the loess. Both these implements are of paleolithic type and the patina upon them and the oxidation of the surface indicate great age. The third implement, which is of a familiar paleolithic type, was found in a gravel pit excavated in a "kame terrace" on the border of the River Styx in Wadsworth, Medina County, Ohio. But it was found on the floor of the pit so that the evidence is not definite

as to its position in the undisturbed gravel, but everything about it is consistent with its glacial age and it is different in almost every respect from the great number of implements found on the surface in that locality. Its character is confirmed by the fact that in a farmer's collection near by another implement almost precisely like it was found and reported to have been from this same gravel deposit a short distance away.

"Characteristic Traits of the Yana Language of California." The Yana language of northern California represents a distinct liguistic stock and was spoken in three dialects (north, central and south), of which one (south) is now extinct. Phonetically it is characterized by the presence of intermediate, aspirated surd and "fortis" stops, by a weakly trilled r, by voiceless l, m, n and r, and by doubled (long) l, m and n. Phonetic processes of morphological significance are vocalic changes in the verb stem in the formation, *e. g.*, of causatives and passives, and the change of l to n in nouns to form the diminutive.

There are two main forms of speech in Yana, one used by men speaking to men, the other in all other cases; the second form is differentiated from the first partly by phonetic, partly by formal modifications. Morphologically Yana is characterized by having practically only two parts of speech—noun and verb (adjectives, numerals, interrogative pronouns and adverbs, and conjunctive elements are all morphologically verbs). The pronominal elements (possessive and subject) are, in the main, identical in both noun and verb, a grammatical differentiation of these parts of speech being brought about largely by syntactic means. The structure of the verb is rather complicated. Besides pronominal suffixes and tense and mode suffixes, all of which are more strictly formal in character, we have stems of first position, which may, in many cases, be directly employed with the requisite formal suffixes, stems of second or other position, which can not be used without a preceding stem of first position, and an immense number of derivational suffixes (local, temporal, relational, quasi-modal, etc.). The total number of non-formal elements that follow stems of first position is easily over three hundred. Prefixes do not occur in Yana.

Mrs. Zelia Nuttall spoke of "A Curious Survival in Mexico of the Use of *Murex purpura* for Dyeing Purposes," producing by way of demonstration two woven fabrics colored purple. The industry is known to exist in Nicoya, Costa Rica. Hartman found it also on the Peninsula of Guanacosta (Costa Rica).

Drs. Charles Peabody and George Grant MacCurdy made a "Presentation of Eoliths from Boncelles," near Liège, Belgium, they having visited that station together last summer. Boncelles lies in the Ardennes at a height of 265 meters above the sea. Here M. de Munck discovered eoliths in a flinty layer surmounted by a thick deposit of upper Oligocene sands. The age of the latter is determined by numerous fossil shells, including *Cytherea beyrichi*, *Pectunculus obovatus* and *Cardium*. According to Rutot the deposit in which the eoliths occur is of middle Oligocene age. The Boncelles eoliths are therefore older than those of Cantal.

Another paper dealing with European archeology, "Some Recent Paleolithic Discoveries," was presented by Dr. George Grant MacCurdy. This paper appeared in the October–December issue of the *American Anthropologist*.

The papers by Dr. C. Hart Merriam: "Mythology of the Mewan Tribes," "Additional Notes on the Yumme or Mourning Ceremony," "The Creation Myth of the Pá-we-nan" and "Battle of the First People with Dakko, the Sun God—a Hamfo Myth," will appear in the *Journal of American Folk-Lore*.

Mr. Stansbury Hagar discussed "Izamal and its Celestial Plan." At Izamal in the north-central part of Yucatan are found a group of ruins which mark the site of an ancient theogonic center of the Mayas. Landa, writing in the latter half of the sixteenth century, gives the earliest reference to them. He mentions eleven or twelve edifices and describes one. Lizana, writing sixty years later, found only five edifices, but he gives us a detailed description of their comparative location and of the traditions associated with them which reveals the basic plan of Izamal. This plan is confirmed by details supplied by the modern travelers, Stephens, Norman, Charnay, Le Plongeon and Holmes.

Lizana says that the buildings were temples; they stood upon the summit of pyramidal mounds typical of Mexico and Central America, as well as Yucatan. Towards the north was the highest temple, called Kinich Kakmo, Sun-Eye and Ara or Parrot of Fire, because the sun was supposed to descend upon it at noon and to consume the offerings upon its altar, as the fiery plumed ara descends from the sky. These symbols were associated with the time of the June solstice.

The Mayan ritual refers to the descent of an "angel" upon the altar at this time and to the new fire festival. A similar Mexican tradition mentions the descent of a bird in a luminous

constellation. The symbolism therefore seems to refer to the annual descent of the sun from the sign Cancer, the northernmost point in the solar journey, at the solstitial noon of the year.

Towards the west was the mound and temple dedicated to Itzamna as lord of the dead. It contained the image of a hand, because on this spot Itzamna healed those who were ill and restored the dead to life by laying his hand upon them, whence it bore the name Cab-ul the Working Hand. In this aspect Itzamna may be identified with the death god A of the codices who rules the Mayan uinal Xul or End in October–November and represents Scorpio, the death sign.

Towards the southwest was the temple of Hunpictok, the Warrior, or the Commander of Eight Thousand Lances. This was an arsenal and the headquarters of the army. Beside one of the two colossal heads upon the facade of this pyramid may still be seen the double spiral xonecuilli symbol which connoted the sign and constellation Sagittarius for the Mexicans. It also referred to the gods of war, and to Orion the Warrior, who represented Sagittarius as a catasterism.

At the south stood the temple of Itzamna in the aspect of the Cosmic Spirit, represented in the codices by the god D and the sign Capricornus.

Finally Lizana describes the temple called Papp Hol Chac, House of Heads and Lightnings. He does not locate it, but Charnay writes of it as facing the Kinich Kakmo pyramid from the south. In it dwelt the priests who administered justice and foretold the future. Apparently the reference is to the tlahtouani or diviner of the Mexicans, Maya chilan, who imparts the wisdom supposed to be obtained from the spirits of the dead, and who is associated with the constellation Teoyaotlatohua, our Libra-Scorpio. In this instance the former sign seems to be represented. Lizana also mentioned four roads which extended from Izamal towards the cardinal points.

Each of the five edifices described by Lizana was associated with a zodiacal sign. Their relative positions correspond correctly to those of the signs they represent. The original plan of Izamal consisted of twelve temples each representing a zodiacal sign in its proper relative position in the zodiacal circle. These structures were grouped around an undefined central space from which the four roads divided the country into four provinces corresponding to the celestial and cosmical quartering of the solar path by the solstices and equinoxes. The basis of this plan was therefore the imitation upon earth of the supposed celestial plan. It is identical with the plan of Cuzco, the Inca capital,[3] a plan most appropriate to a sacred city of priests who watched the stars. The Izamal symbols repeat throughout those of Peru, indicating intercommunication, direct or indirect, between the Mayas and the Peruvians at some time.

In "Social Institutions of the Tinglayan Igorrotes," Mr. Daniel Folkmar gave some of the results of his work for the Ethnological Survey of the Philippine Islands while Lieutenant Governor of Bontoc.

The following papers were read by title:

Measurements of Mixed and Full-blooded Dakota Children: Dr. Clark Wissler.

Height in the American Indians: Dr. Aleš Hrdlička.

Memorial Address for Otis T. Mason: Dr. Walter Hough.

Archeological Explorations in Manitoba: Professor Henry Montgomery.

Some Inventions of the Ancient Hawaiians: Mr. William A. Bryan.

Committee Report on the Preservation of American Antiquities: Dr. E. L. Hewett (Secretary).

Ballads and Songs of Western North Carolina: Miss Louise Rand Bascom.

Folk-Lore from the Southern States: Dr. John P. Cross.

Folk-Music in America: Mr. Phillips Barry.

Notes on the Northern Wintun Indians: Mr. F. B. Washington.

Traditions of the Coos Indians of Oregon: Mr. Leo Forchrenberg.

Observations on Esoteric Narratives on the Science of Myths: Dr. Clark Wissler.

Sketch of the Yuchi Language: Dr. Frank G. Speck.

Songs of the Western Cowboys: Mr. George W[illegible].

The Importance of Recording Negro-Lore, Dialects and Melodies: Miss Mary W. F. Speers.

George Grant MacCurdy,
Secretary

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION K—PHYSIOLOGY AND EXPERIMENTAL MEDICINE

SUMMARY OF THE PROCEEDINGS

There were two meetings of the section in the auditorium of the physiological building at the Johns Hopkins Medical School during convocation week, as follows:

[3] See author's paper on "Cuzco, the Celestial City," in *Proceedings of the International Congress of Americanists*, New York, 1902.

First Session.—Tuesday afternoon, December 29, 1908. Presiding officer: Vice-president William H. Howell. The program consisted of: (1) an address by the retiring vice-president, Ludvig Hektoen, on Opsonins and other Antibodies,[1] and (2) a symposium on The Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene.

Second Session.—Wednesday afternoon, December 30, 1908. Presiding officer: Vice-president William H. Howell. Joint session with the American Physiological Society, the Society of American Bacteriologists and the American Society of Biological Chemists. This session was devoted to three *general* papers (see scientific proceedings below).

EXECUTIVE PROCEEDINGS

The following officers were elected for the ensuing term:

Vice-president of the Association and Chairman of the Section—Charles Sedgwick Minot.

Secretary—George T. Kemp.

Sectional Committee—William H. Howell, vice-president, 1908–9; Charles Sedgwick Minot, vice-president, 1909–10; George T. Kemp, secretary, 1909–13; Frederick G. Novy (one year), Graham Lusk (two years), Jacques Loeb (three years), E. P. Lyon (four years), William J. Gies, secretary 1904–9 (five years).

Member of the Council—W. G. MacCallum.

Member of the General Committee—William W. Ford.

SCIENTIFIC PROCEEDINGS

I. FIRST SESSION.—(1) Vice-presidential address and (2) symposium on college athletics.

Program

Address by the retiring chairman, Dr. Ludvig Hektoen, professor (and head of the department) of pathology and bacteriology, University of Chicago. Subject: Opsonins and other Antibodies.[2]

Symposium—Subject: "The Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene."

Introductory remarks by the chairman, Dr. William H. Howell, professor of physiology, and dean, Johns Hopkins Medical School.

The Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene: Dr. R. Tait McKenzie, professor of physical education, University of Pennsylvania.

On the Physiological Effects of Moderate Muscular Activity and of Strain: Dr. Theodore Hough, professor of physiology, University of Virginia.

Physical Exercise from the Standpoint of Physiology: Dr. Frederic S. Lee, professor of physiology, Columbia University.

Departmental Organization for the Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene: Dr. Thomas A. Storey, associate professor and director of physical instruction, College of the City of New York.

General discussion.

II. SECOND SESSION.—General papers in joint session with the American Physiological Society, the Society of American Bacteriologists and the American Society of Biological Chemists.

Program

Anaphylaxis: Dr. M. J. Rosenau, director of the hygienic laboratory, Public Health and Marine Hospital Service, U. S. A., Washington.

The Physiological Significance of Creatin and Creatinin: Dr. Lafayette B. Mendel, professor of physiological chemistry, Sheffield Scientific School, Yale University.

The Venous Pulse: Dr. Albion W. Hewlett, professor of the theory and practise of medicine and clinical medicine, University of Michigan.

General discussion.

PAPERS AND ABSTRACTS (I. AND II.)

I. Papers comprising the symposium on The Regulation of Physical Instruction in Schools and Colleges from the Standpoint of Hygiene. By Drs. Mackenzie, Hough, Lee and Storey. (To be published in SCIENCE, March 26 and April 2.

II. Papers comprising the program of the joint session with the bacteriologists, biochemists and physiologists. By Drs. Rosenau, Mendel and Hewlett.

Anaphylaxis: M. J. ROSENAU. (Will be published in the *Archives of Internal Medicine.*)

The Physiological Significance of Creatin and Creatinin: LAFAYETTE B. MENDEL. (Will be published in SCIENCE.)

The Venous Pulse: ALBION WALTER HEWLETT.

The typical venous pulse consists of three main waves which have been designated the *a*, *c* and *v* waves, respectively. A comparison of the jugular pulse with that of the carotid artery shows that the *c* wave occurs almost simultaneously with the carotid pulse. The *a* wave precedes the *c* wave

[1] See SCIENCE, Vol. XXIX., p. 241, 1909.

[2] See SCIENCE, Vol. XXIX., p. 241, 1909.

by an interval of about 0.18 second. It is caused by the contraction of the auricle. In some tracings the *a* wave is very prominent, greatly overshadowing the succeeding *c* wave. This was noted particularly in patients with more or less decompensation, though it is not pathognomonic of such conditions.

The *c* wave occurs almost simultaneously with the carotid pulse and in some instances it is caused by a transmitted arterial pulsation. The earlier writers, especially Francois Franck, Fredericq and Gerhardt regarded the *c* wave as a true venous wave, but Mackenzie and Wenckebach believe that it is always a carotid pulse. Recent investigations, however, tend to show the correctness of the earlier views; for, (1) the *c* wave can often be recognized by inspection as being present in the veins themselves, (2) it often precedes the carotid pulse by about 0.02 second, (3) it has a different form, (4) it can occasionally be demonstrated on liver tracings, and (5) in pathologic venous tracings, especially from cases of auricular paralysis, the *c* wave on the jugular differs in size from the radial pulse, often being largest when the radial is smallest. In most tracings, therefore, the *c* wave is of venous origin; when of arterial origin, this is generally indicated by its form.

The venous *c* wave is probably to be referred back to the momentary increase in intra-auricular pressure which occurs at the onset of ventricular systole. This wave of increased pressure appears somewhat later in the neck on account of the slow transmission of venous waves.

The negative wave following the *a* wave is undoubtedly due to auricular diastole. That following the *c* wave may also be explained in part by auricular diastole; but it is evident (1) from heart block tracings and (2) from tracings of auricular paralysis from man and from animals that ventricular systole alone is capable of causing a negative wave in the venous pulse just after the *c* wave. This is caused by the descent of the ventricular base during systole, which opens up the auricle on its attachments to the great veins.

Tracings from a patient with palpitation showed a very marked *c* wave and a very marked depression immediately following. As other venous waves were merely indicated on the tracing, it seems probable that the earlier movements of the ventricle during systole were executed with unusual speed.

The *v* wave appears in the neck just after the time of the dicrotic notch on the arterial pulse. Owing, however, to the slow transmission of venous waves the *v* wave begins in the heart at a somewhat earlier period, probably in late systole, and it is terminated there by the opening of the tricuspid valves. It is probably due partly to a replacement of the base of the ventricle toward the auricle at the onset of diastole. It is also due in part to the accumulation of blood in the auricle during the closing of the tricuspid valves. The *v* wave is accentuated in conditions of auricular stasis especially in tricuspid insufficiency and auricular paralysis.

The negative wave following the *v* wave is due to the opening of the tricuspid valves and the consequent flow of blood toward the ventricle. It is especially pronounced in conditions of auricular stasis. In slowly acting hearts this negative wave is often followed by a shoulder on the venous tracing which seems to be due to a recoil from the rapid filling of the ventricle.

William J. Gies,
Secretary

SOCIETIES AND ACADEMIES

THE WASHINGTON ACADEMY OF SCIENCES

Dr. Alfred G. Mayer, of the Carnegie Institution of Washington, delivered an address before the Washington Academy of Sciences Tuesday evening, February 23, on "The Tortugas Marine Laboratory, its Scope and Aims." Dr. Mayer kindly furnished the following abstract of his address:

"The lecturer called attention to the fact that this laboratory is the only permanent marine station within the American tropics, and that the generous support accorded to it by the Carnegie Institution of Washington had enabled it to develop into the best equipped marine laboratory in the tropical world.

"The seven Tortugas Islands are out in the Gulf of Mexico, seventy miles west of Key West, and consist of coarse wave-washed and wind-blown fragments of marine shells, which afford no soil suitable for the growth of mangroves; and thus the laboratory is unique in being the only place on the seaboard of Florida which is free from endemic mosquitoes in summer.

"Along the mainland coast of southern Florida the winds cause the waters over the coral flats to be churned into a silky mass of suspended silt, which is fatal to pelagic life, but at Tortugas, owing to the great area of deep ocean water in their neighborhood and the small size of the coral

plateau around them, this is not the case. The islands lie on the leeward side of the Gulf Stream, and the rich pelagic life of the great tropical current is constantly drifted upon their shores.

"Expeditions have for generations brought tons of preserved specimens of tropical forms home to our museums and colleges, where they have been studied and named, but as yet we know sadly little of the *living* animals of the tropics, their habits, development and physiology. The laboratory, therefore, aims chiefly to encourage research in these new fields, and to this end many of our leading investigators and most promising young workers in research have been invited to pursue their studies at Tortugas.

"The laboratory is now entering upon its fifth year. Two volumes of its researches have been published by the Carnegie Institution, and ten other papers have been published in various scientific journals, and the amount of research work now in press greatly exceeds that yet published.

"The lecturer then reviewed some of the more generally interesting, although not necessarily the most important, researches, as follows: The late Professor William K. Brooks, of Johns Hopkins University, carried out interesting studies of the pelagic *Solfæ* of the Tortugas, his papers being excellently illustrated by the drawings made by Mr. Carl Kellner. Brooks and McGlove find that the lung of the prosobranchiate gasteropod *Ampullaria* is developed out of a thickening, or ridge, of the epithelium of the mantle, and arises simultaneously with the gill and osphradium, all three being homologous organs. There is probably no phylogenetic relationship between the lung of *Ampullaria* and that of the pulmonates. *Ampullaria* is a large brown snail which lives in the fresh water of the Everglades, and lays eggs in pearl-like clusters on the stems of grasses above the water-line.

"Mr. Frank M. Chapman, of the American Museum of Natural History, describes the nesting habits of the booby (*Sula leucogastra*) and of the frigate bird (*Fregata aquila*) upon the isolated rocky island of Cay Verde in the Bahamas. Permission to study these birds was generously granted by his excellency, Sir William Grey-Wilson, in his official capacity as governor-in-council of the Bahamas. Specimens for a 'group' of the frigate birds were collected and these are now beautifully displayed in the American Museum in New York. Mr. Chapman found the nesting season of both boobies and frigate birds to be at its height early in April, the birds having apparently come to the island to nest in February. He found that the boobies always lay two eggs, but rear only one young bird.

"Professor Edwin G. Conklin, of Princeton University, studied the structure of the egg of the 'thimble jellyfish,' *Linerges mercurius*, which appears in vast breeding swarms upon the surface in the spring at Tortugas, and the Bahamas. He discovered that these medusæ always spin in an anti-clockwise direction as they progress through the water if viewed from the oral pole. The eggs consist of three easily distinguished substances. A peripheral layer of clear protoplasm which becomes the peripheral layer of the embryo and gives rise to the cilia, an intermediate layer of closely crowded yolk spherules which constitute the principal parts of all of the cells of the gastrula and blastula, and an inner mass of dissolved yolk which is poured into the cleavage-cavity and probably serves as a source of nourishment.

"Dr. R. P. Cowles, of Johns Hopkins, made an elaborate study of the habits of the 'ghost crab,' *Ocypoda arenaria*, and finds that it probably can not distinguish color as such but detects simply a difference between light and shadow. It can form simple associations and displays memory. It has apparently no sense of hearing, but its otocysts are organs of equilibration. It changes color under the influence of light and temperature, but this change does not occur if the crab's eyes be blackened.

"Dr. H. E. Jordan, of the University of Virginia, carried out a very elaborate series of studies upon the histological structure of the eggs of echinoderms and of the walking-stick-insect, *Aplopus*. The germinal spot in echinoderm eggs appears to be in part at least a storehouse of material which is to contribute in the formation of the chromosomes. He finds in *Asterias* and *Hipponoë* that the chromosomes do not arise out of the nucleolus, but the latter contribute nutritive substance to them. In the walking-stick-insect, *Aplopus*, he finds that half of the spermatozoa have eighteen, and half seventeen chromosomes, and the accessory chromosome is large and U-shaped and probably determines the female sex.

"Dr. Charles R. Stockard, of the Cornell Medical College, and Dr. Charles Zeleny, of Indiana University, found, working independently, that in the scyphomedusa *Cassiopeia xamachana* removing a greater number of the mouth-arms causes each and every arm to regenerate faster. Stockard finds also that although regeneration of each and

every arm is more rapid the greater the number of arms removed yet this regeneration is carried on at the expense of the normal body tissues which shrink while the arms grow, thus recalling the case of cancerous growths which, having more ability to absorb nutriment than the normal body tissues, grow at the expense of the body itself. Stockard finds also that the nearer the cut surface is to the center of the disk of the medusa the more rapid the regeneration. He finds that regeneration is somewhat retarded by a slight excess of NaCl, very much retarded by $CaCl_2$, but not appreciably affected by Mg. A slight excess of KCl accelerates, and a strong excess retards regeneration. Zeleny, working upon the gulf-weed crab, *Portunus sayi*, finds that successive removals of appendages neither increase nor decrease the rate of regeneration of the successively removed part.

"An interesting series of observations were carried on by Dr. Stoddard in which he shows that the habits of the walking-stick-insect, *Aplopus*, accord perfectly with the general resemblance of the animal to a stick. He discovered that the males will mate with the cut-off terminal part of the female's abdomen if this be mounted upon a stick.

"Professor Jacob Reighard, of Michigan University, investigated the problem of 'warning coloration' in so far as it affects the brilliantly colored reef fishes and their enemies, and he shows conclusively that these brightly colored fishes are at once greedily devoured if they leave the shelter of the coral reefs. The commonest predatory fish of the Tortugas, the gray snapper, *Lutianus griseus*, can, however, be *taught* to avoid a fish rendered artificially distasteful, and will remember its experience and still avoid the possible prey for at least twenty days after it has had the evil experience of attempting to devour such a fish. The coral-reef fishes are, therefore, *not* warningly colored, yet warning color *could* exist, but apparently it does not in nature; at least in so far as the reef fishes experimented with are concerned.

"Professor John B. Watson, of Johns Hopkins University, remained for three months upon Bird Key, Tortugas, studying the reactions of the noddy (*Anodus stolidus*) and sooty (*Sterna fuliginosa*) terns. This work was conducted under conditions of great inconvenience, for the temperature of the air under the bushes is commonly 123° F. at noon. Professor Watson found about 1,400 noddies, and 18,800 sooties nesting upon this little island not a quarter of a mile wide. While the noddy is building its nest in the bushes early in May it is very shy, but as soon as the egg is laid its habits change and it will remain and defend the egg. If, however, an egg be artificially placed in an unfinished nest the habits of the birds at once change and they settle down upon the egg and defend it. They do not recognize their own eggs, and will sit upon hens' eggs, sooty terns' eggs, their own eggs painted red, green or black, or an artificially egg-shaped piece of magnesium sulphate. The sooty tern, however, will not usually accept colored, or strange-looking eggs. The noddies relieve each other on the nest at intervals of about two hours, the new-coming bird crowding the sitting mate off the nest.

"The sooty tern makes its nest upon the ground. It is greatly confused and may lay a new egg if the egg be moved twenty-two inches horizontally from the original place, but the egg may be raised or lowered many feet in a vertical direction and the bird alights upon it at once apparently undisturbed.

"The young birds of both species can be taught to go through a labyrinth for their food; and the old sooties can learn to go through a maze to their egg, or to open a cage to obtain access to the egg. Neither of these birds is in the habit of going more than about seventeen miles from the island for their supply of fish, yet when they were taken away in the holds of vessels and liberated at Key West, Havana and Cape Hatteras they returned to the island. In the case of the sooties, the return from Cape Hatteras to Bird Key was made in five days, the straight-line distance being 850 and the 'along-shore' route 1,081 statute miles. There are many other important observations recorded in Professor Watson's paper.

"The lecturer expressed regret that limitations of time prevented his presenting before the academy the results of other interesting studies which had been conducted by investigators at Tortugas, but would refer his audience to the papers of Jennings, Linton, Perkins and others who had published accounts of their researches at the laboratory."

The paper was discussed at considerable length by C. Hart Merriam, Austin H. Clark and T. S. Palmer, who heartily commended the work of the Tortugas laboratory, and referred to similar laboratories and their work in various parts of the world.

J. S. Diller,
Recording Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 661st meeting was held on February 27, 1909, Vice-president Abbot in the chair. The following papers were read:

The Relation between Sky Polarization and the General Atmospheric Absorption: Mr. H. H. Kimball.

Rayleigh has shown that sky polarization may be attributed to the presence of particles in the atmosphere whose diameters are small as compared with the wave-length of light, and the researches of Barus indicate that such particles must be "an integrant part of the air" and "could scarcely be separated from it except by filtration." We can not, therefore, expect marked fluctuations in the intensity of the polarized component of sky light.

On the other hand, the intensity of the unpolarized component will vary with the amount of light scattered by particles in the atmosphere whose diameters are large as compared with the wave-length of light, and with the amount reflected from the surface of the earth and from clouds.

Eliminating reflection from clouds, and allowing for variations in the reflection from the earth's surface, there remains as a variable factor the scattering of light by large particles in the atmosphere.

The intensity of the unpolarized component of sky light should, therefore, be a function of the number of such particles present, and consequently of the general absorption or diffusion of light by the atmosphere.

From observations with an Angström pyrheliometer and a Pickering polarimeter at the Central Office of the Weather Bureau, an empirical equation has been developed showing the relation between sky polarization and the general atmospheric absorption. By means of this equation polarimeter observations are now employed to check the computations of the value of the solar constant from readings of the pyrheliometer and the psychrometer by a method shown in Bulletin of the Mt. Weather Observatory, Pt. 4, Vol. 1. The results indicate a close relation between sky polarization and the general atmospheric absorption.

The Principles of Machines for Liquefying Gases: Dr. Edgar Buckingham.

The speaker discussed the principles involved in the action of simple liquefying machines as distinguished from cascade processes with one or more precooling stages. The total cold available depends only on the pressures between which expansion takes place and the initial temperature of the gas; and with the ordinary type of liquefier is quite independent of the internal arrangement of the apparatus. The fraction of the gas that can be liquefied may be computed from its thermal and mechanical properties, if these are known; and the computed values agree very closely with those found by experiment. The increase in yield attainable by avoiding part of the dissipation within the liquefier may also be computed, and is very considerable. Methods for obtaining this improved yield were discussed briefly.

R. L. Faris,
Secretary

THE ACADEMY OF SCIENCE OF ST. LOUIS

The regular meeting was held on Monday, February 1, 1909, at the academy building, 3817 Olive Street, the program of the evening having been especially arranged in celebration of the centenary of the birth (February 2, 1809) of Dr. George Engelmann, one of the founders of the academy, and its first president. Standing not only among the leading medical practitioners of the last generation, Dr. Engelmann was also one of the foremost botanists of his day; for, during the many years of an active, useful life, most of which was spent in St. Louis, he found sufficient time, in the leisure hours of his practise, to devote to a series of most valuable scientific investigations. And, moreover, in addition to his professional and botanical labors, he was a zealous meteorological observer, keeping observations pertaining to atmospheric phenomena for over forty years.

Dr. Baumgarten opened the program of the evening with a very interesting paper, entitled "The Personality of Engelmann." And Dr. Baumgarten, having been a personal friend of the physician and botanist, was peculiarly well fitted to handle this subject, which he treated in a reminiscent way, making characterizations of a personal rather than mere biographical nature. This tribute of Dr. Baumgarten to the memory of his friend was one that bespoke only the most sincere friendship for Dr. Engelmann, and the highest appreciation of his character and achievements.

Professor H. A. Wheeler presented a paper on "Engelmann's Contributions to Geognosy." For Engelmann's reputation extended beyond the borders of his master work in botany and his devotion to local meteorology; although his influence in geognosy is perhaps due less to actual work done in that field than to the stimulation

he inspired in specialists of that department. In 1859 he published a paper that concerned itself with the elevation of St. Louis above sea level, which, aside from its general interest and scientific value, was especially important in that St. Louis was then the point upon which were based the computations for determining the altitudes of such places in the far west as were visited by the early exploring expeditions of Nicollet, Fremont, Owen and Emery. Engelmann, after a series of barometric observations in 1853, determined a directrix of 404.9 feet for the city of St. Louis—a figure which differed by only 7.8 feet from the later 412.7 feet mark as determined by precise leveling of government deparments, and by only 2.2 feet from the original 410.5 of Nicollet which was made in 1841 by barometric determinations based upon data furnished by Engelmann himself. While the contributions of Engelmann seem slight when compared with his masterly work in botany and meteorology, they are, nevertheless, a valuable index of the breadth of the man, of the keen interest he took in the natural sciences, and of his mental caliber and scientific training.

Professor Nipher, of Washington University, in a paper, "Engelmann's Work in Meteorology," told how Engelmann began his meteorological observations when he first settled in St. Louis, and how he continued them for nearly fifty years. Dr. Nipher explained how this long series of observations enables us to determine the normal rainfall and temperature for St. Louis, and how they, in turn, are useful in fixing extremes of temperature and rainfall. In 1861, Engelmann published the results of his rainfall observations, which show that June is by far the month of greatest precipitation; and he pointed out that the June rise in the Mississippi is not due to the melting of snows in the mountains, but to heavy and wide-spread spring rains. The fact that Engelmann gave attention to the rate of rainfall is noteworthy because that is a quantity which must be considered in the design of bridges and other structures that are to carry flood water. After remarking that Engelmann made an early study of the differences of temperatures and humidity in the city and in Shaw's Garden (which was, he said, on an open prairie three miles from the city), Dr. Nipher concluded with the statements that Engelmann was continuously in cooperation with the weather service in charge of the Smithsonian Institution, and that in many ways his aid was solicited by government officials in charge of work in the far west.

Dr. Trelease, of the Missouri Botanical Garden, which possesses Engelmann's invaluable collections, concluded the program of the evening with a paper on "Engelmann as a Biologist." He showed a number of drawings which exhibited Engelmann's skill in picturing details of plant structure, among them those made for his thesis, which was published in 1832, as well as the large quarto volume in which his botanical publications were reprinted at the expense of Henry Shaw in 1887, under the editorial direction of the great botanist Asa Gray, of Harvard University. To these were joined specimens of the beautiful prairie flower named *Engelmannia* in his honor, and of the blue spruce of Colorado which also bears his name. Tersely epitomizing Engelmann's work, and analyzing the economy of time and directness of purpose which enabled him to accomplish in the leisure hours of a busy physician's life more than the average achievement of a botanist whose whole effort is directed to his specialty, Mr. Trelease closed by quoting from Engelmann's gifted biographer, Professor Sargent, of Harvard University, the prediction that "the western plains will still be bright with the yellow rays of *Engelmannia*, and that the splendid spruce will still cover with noble forests the highest slopes of the Rocky Mountains, recalling to men, as long as the study of botany will occupy their thought, the memory of a pure, upright, laborious and stimulating life."

At the conclusion of the memorial session, the members and guests of the Academy were invited to pass into another room, where were displayed a number of interesting objects connected with or commemorative of Engelmann's life and work. Under the guidance of Mr. H. C. Irish and Mr. Chas. H. Thompson, who explained the several objects, an interesting half hour was spent in the inspection of this exhibit, which included the manuscript and original sketches for Engelmann's thesis as well as the publication itself in a copy with partly colored plates; several volumes of his many thousands of unpublished notes and sketches; the simple dissecting microscope and the elaborate compound microscope made by Hachet; the jubilee medal struck by the academy in 1906, bearing Engelmann's portrait; an illustration of the Colorado Engelmann spruce; and specimens and original descriptions of the three genera of plants that have been dedicated to his memory in the name *Engelmannia*.

W. E. McCourt,
Recording Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 2, 1909

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

PHYSICAL EXERCISE FROM THE STANDPOINT OF PHYSIOLOGY[1]

MYTHOLOGISTS tell us that Æsculapius, the god of healing, was slain by a thunderbolt from Zeus because of complaints which had reached that deity that Æsculapius had become so skilful in his art that Hades was fast being depopulated. His tragic end, however, did not deter his courageous daughter, the goddess of health, from carrying on a vigorous propaganda; and, whatever the immediate result of her efforts, I am quite sure that her followers, the hygienists of the present day, are even more successful than are the doctors in delaying the day of our entrance into a future life. It has been many centuries since offerings to Hygeia were laid on her altars on the Grecian hills, but the aim of her cult has not changed. This aim, as I conceive it, is to bring to, and maintain at, its highest efficiency the organic machine. An unhealthy body is a pathological body, and any method is a legitimate hygienic method which tends to keep the body in a physiological status. Hygiene has been well called applied physiology.

What are the criteria of efficiency in a living body? One criterion is that the body's chemical processes shall proceed

[1] An address delivered in a symposium on "The Regulation of Physical Instruction in Schools and Colleges, from the Standpoint of Hygiene" before Section K (Physiology and Experimental Medicine) of the American Association for the Advancement of Science, Baltimore, December 29, 1908.

in a rapid, orderly and economical manner. Chittenden has taught us to beware of an excessive quantity of protein food, even though it may be questioned whether it is most economical to reduce our daily protein intake to as low a point as forty or fifty grams. Digestion should not be delayed. Oxygen starvation is most deleterious; and the two requisites for a sufficient intake of this essential element are, first, a sufficient supply outside the body and, secondly, an efficient respiratory mechanism. It can hardly be questioned that a rapid anabolism and a rapid katabolism are advantageous. The storage of much nutriment in the cells, in the form of glycogen or fat, is like putting one's money in a safe-deposit compartment, where it lies with no interest return to its owner. Food should be quickly utilized, either to form protoplasm or to yield energy. There is also reason to believe that intermediate katabolic products are harmful to the tissues, and that they should be quickly turned into the final excretory products and cast out. Thanks to the labors of Starling and others, we are now beginning to realize how far-reaching is the control of the various tissues by distinct chemical bodies, or hormones, produced in other tissues. Any interference with the production of hormones is obviously an obstacle to efficient action.

A second criterion of efficiency is that the body's physical, as distinct from its chemical, processes shall be adequate to the body's needs. Voluntary and involuntary muscles should possess size, toughness and contractile power sufficient for both ordinary and extraordinary demands. The heart should be able to resist a high blood pressure without detriment to its muscle fibers or valves. The capillary bed should be capacious. Vasomotor response should be ready. Respiratory organs should be capable of quickly bringing in oxygen and quickly eliminating carbon dioxide. Osmotic exchange should be rapid. Secreting and excreting organs should be richly supplied with blood and lymph, and capable of quickly supplying their products. The amount of energy utilized in mechanical work should be as high as possible in proportion to the total amount of energy expended, and the work of Zuntz and others has shown that the former can be largely increased by training.

A third criterion of efficiency is accuracy and delicacy in the activity of the organs of special sense.

And a fourth criterion of efficiency is a skilful working central nervous system, playing its part effectively, whether with or without psychic accompaniments, and by means of excitation and inhibition exerting an adequate coordination and control of all the bodily processes.

From this summary of some of the factors that make up physiological efficiency I turn to one of the most important obstacles to its development. This is fatigue. Fatigue is a general biological phenomenon —wherever protoplasm exists, there fatigue is possible. Given everything else, it is fatigue that loses races and it is absence of fatigue that wins games. Fatigue occurs in both physical and psychical processes. It is normal, and yet it may easily overstep its ill-defined normal boundaries and become markedly pathological. While originating, it may be, in one tissue, it radiates to all others and touches the most remote. It manifests itself in striking physical phenomena, yet it is primarily a chemical one —a phenomenon of metabolism. It seems strange that, with all the centuries during which mankind has struggled against it, fatigue should still remain largely an unsolved problem. We seem to be on the

right track, but our progress seems immeasurably slow.

Not only logic but experiment tell us that fatigue has a twofold cause—diminution of substances essential to protoplasmic activity—and here oxygen and carbohydrate loom large—and accumulation of toxic products of katabolism, among which we reckon carbonic dioxide, paralactic acid and monopotassium phosphate.

That lack of oxygen is a potent factor seems probable from Hill's recent results, which seem to demonstrate the efficacy of pure oxygen taken into the lungs in quickly restoring one who is suffering extreme fatigue.

That lack of carbohydrate is in part responsible for fatigue seems evident from the abundant testimony, coming not only from daily human experience, but from many laboratory experiments, conducted by a great variety of methods, to the effect that sugar restores the working power of the fatigued neuro-muscular mechanism. In view of the complexity of the chemical changes involved in protoplasmic activity, it seems hardly possible that fatigue substances are limited to two end products of metabolism, carbonic dioxide and a phosphate of potassium, and one intermediate product, paralactic acid. Indeed, Weichardt has gone beyond this and claims to have found among the products of extreme muscular activity a specific toxin, which is analogous to bacterial toxins and capable of producing the symptoms of fatigue when injected into animals. And he further claims to have produced, by methods analogous to those employed with bacterial toxins, a specific antitoxin possessed of striking recuperative powers. These claims he supports by a large amount of experimental evidence. Without a repetition of his procedures—and I am unaware that any one has yet done this—it is difficult to express an opinion of value concerning the existence of his toxin and antitoxin. That he obtained from the tissues of his fatigued animals a poison of a high degree of toxicity seems undoubted; that this is capable of ready neutralization is less clear; and a sceptic may be inclined to be dubious of the specificity of Weichardt's products. The preparation of his antitoxin in this country is now protected by patents issued from Washington, and it is gratifying to feel that if it prove to be the long-sought antidote to fatigue, now commercialized it will come within the provisions of our pure food law.

Whether future research justifies Weichardt's claims or not, our conception of fatigue substances is bound, I think, to become extended. My study of the physiological actions of the three now recognized, and the similarity of these actions to those of β-oxybutyric acid, indol and skatol, have brought me to the conviction that we shall in the future probably find many intermediate products of metabolism which have the power of depressing protoplasm and putting it into the condition wherein it manifests the physical characteristics of fatigue. If this conviction proves to be well founded, we shall in the future recognize many fatigue substances. It may be convenient to regard some of these as normal and some as pathological, although I am inclined to interpret the difference between these two hypothetical groups as one of quantity rather than of kind.

We are still in the dark as to the respective parts played in the production of fatigue by its two so-called causes. Verworn's limitation of the term fatigue to the result of poisoning by toxic substances, and of the term exhaustion to the effects of the lack of substances essential to activity, is a convenient usage, but it should be borne in mind that both processes go hand in hand throughout the activity of the tissue, and even in what is popularly understood by

the term exhaustion there are evidences of the profound action of toxic substances.

Ever since Eukles, the progenitor of Hayes, Dorando and Longboat, ran and won the first Marathon race and gave his life for the privilege of announcing to the Athenians the victory of Miltiades, the phenomena of fatigue have been of profound interest. The cause of the death of Eukles can only be conjectured, but the laboratories, the gymnasia and the race tracks of modern days have given us many data of value. Without attempting to review completely the chemical, physical and psychical phenomena of fatigue, let us consider some of the most common and most striking of these. The universal characteristic of fatigued muscle is that its lifting power for a given stimulus is diminished. In the voluntary muscles of cold-blooded animals the process of relaxation is always slowed, often enormously, but this does not seem to occur with warm-blooded muscles. There seems no doubt that the muscles can endure, without detriment, great abuse from both of the factors engaged in the causation of fatigue. Any one who has observed the activity of an isolated and electrically stimulated muscle, from which the blood stream has been cut off and from which the accumulated fatigue substances are occasionally washed by a stream of oxygenated physiological salt solution, can not fail to be impressed by the long continuance of the muscle's activity and the enormous resistance to exhaustion which it shows, even when no food enters it. The muscle possesses within its cells material for performing an incredible amount of work. And no less resistance is shown by the trained muscle to the action of fatigue substances. Thurston estimates the average amount of a man's work per day as two million foot pounds. Carpenter calculated that in the last of the old-style six-day bicycle races, held in New York in 1898, the winner, Miller, performed on the first day more than fifteen million foot pounds of work, and on each of the six days an average of more than nine and one half million foot pounds, the latter being nearly five times man's daily average. Notwithstanding this great effort, Miller competed during the following month in a twenty-four hour race, and two months thereafter he won a second six-day race, breaking his previous record.

The results of fatiguing muscular effort are not confined to the muscles. The proper conditions for fatigue are, at the same time, presented to the nervous system, partly because of its own efforts and partly through the fatigue substances of muscular origin circulating in the blood. It is unfortunate that we know so little regarding the capability of fatigue of the nervous system. The one certain fact is that the nerve fiber can be fatigued only with difficulty. The former and still common idea that the brain and spinal cord are readily fatiguable and, in fact, are the first part of the individual to succumb in a contest, seems not to be justified by the experimental work of Hough, Storey, Woodworth, Joteyko, Kraepelin and others. In attempting last year to discover an efficient method of fatiguing the spinal cord by artificial stimulation, I could find no conclusive evidence that genuine fatigue had been accomplished. Sensations of fatigue are a resultant, chiefly, of the fatigue of tissues situated outside the brain and spinal cord. It seems not unreasonable, therefore, to believe that the central nervous system is highly resistant to fatigue. It is a noteworthy fact that it is the last part of the body to lose in weight in starvation—all the other tissues contribute of their substance that it may be preserved. In certain diseases, too, it is the last tissue to be attacked. When one considers the indispensable rôle which it plays in the drama

of the organism, and the fact that if it succumbs all will be confusion and the curtain must be rung down, the resistance of the central nervous system to fatigue would seem to be, like the known resistance of the nerve fiber, an essential fact of the animal economy. Yet nervous fatigue is an undoubted fact and is manifested by easily recognized physical and psychical phenomena. Fatigue from overwork is one of the common causes of neurasthenia.

The behavior of the heart in a fatiguing physical effort is always a matter of great interest. When an individual is called upon to perform intense and especially prolonged work, the heart is largely the key to the situation. There is no question but that the work of the heart is then enormously increased, partly because of the heightened arterial pressure, and partly because of the greater demands of the tissues for oxygen. McCurdy found that during a combination of the back and leg lift used in the physical examination of college students, the blood pressure, as measured in the upper arm by the sphygmomanometer, rose more than sixty per cent. After long-continued efforts, such as in the Marathon runs, the heart is always dilated, and often there are murmurs, indicative of valvular insufficiencies. It is not clear whether cardiac dilatation results solely from the excessive arterial and intraventricular pressure, or whether this undoubted cause is not reinforced by diminution of the tonus of the heart muscle due to the action of the fatigue substances. Indeed, the direct action of fatigue substances on heart and arteries is much in need of study. A sudden and acute dilatation may be a very serious matter, either endangering the life of the individual at the time or leaving permanent pathological effects. In a well-trained heart, however, there ought to be hypertrophy, as there is in a well-trained voluntary muscle, and it does not appear that dilatation and hypertrophy are necessarily deleterious results of severe physical effort.

Besides cardiac dilatation, severe effort may produce other mechanical effects, such as hernias, the rupture of muscles and of blood vessels, and even the fracture of bones, but these must be looked upon as adventitious phenomena, possible but not probable sequelæ of excessive effort.

Both albumin and casts are very frequently found in the urine after excessive physical effort, usually so with Marathon runners. Why this occurs is not clear, but from the apparent causative connection of the toxins of infectious diseases with albuminuria, it may be questioned whether the albuminuria of fatigue may not be due to the action of fatigue substances on the renal cells. In this connection a recent discovery by Pearce and Sawyer is interesting. They found that the serum of dogs suffering from artificially produced nephritis, when injected into normal dogs, caused protein to appear in the urine. This discovery suggests the question whether there is a fatigue toxin which acts upon the kidneys as a nephrotoxin.

Excessive effort frequently brings on a high temperature, which may last for days afterward. It seems probable that this fatigue fever, like the fevers caused by bacterial toxins, is due to the action of toxic fatigue substances, but here again accurate study is wanting.

The metabolic changes in the body involved in fatiguing effort are much in need of investigation by modern methods. Our present knowledge of these changes need not here be discussed.

Fatiguing effort may thus result in a large variety of phenomena. Some of these have purely mechanical causes, but the majority of them may probably be traced primarily to the action, on the tissues, of the specific fatigue factors. The phenom-

ena are naturally more pronounced in those persons who are physically untrained. I shall not deal here in detail with the physiology of physical training, with its resulting hypertrophy of heart and voluntary muscles, and increase in strength, and in quickness and accuracy of movement. But I would emphasize one point, namely, that a most important element in training is the adaptation of the tissues to the toxic fatigue substances. Without this all the other benefits of training would avail nothing. It is well known that the body can adapt itself remarkably to even large quantities of poisonous drugs, when those are taken first in small and then in gradually increasing doses, extending over a long period. Exactly the same thing is found in physical training properly conducted. Moderate but increasing amounts of exercise, producing moderate but increasing amounts of fatigue substances, put the tissues into a state of tolerance or resistance, such that when the supreme effort is demanded of them, they do not succumb. He who wins is he who can best resist the poisons of fatigue.

What now is the teaching of physiology regarding physical exercises and physical contests?

In the first place, physiology teaches that the human body is capable of responding to enormous demands for physical effort. One's latent power in all of the three varieties of physical exercise—of strength, of speed and of endurance—is never realized except in emergencies, and then it often proves remarkable.

Secondly, physiology teaches the great value of proper training in increasing one's latent power. Yet training can easily defeat its object. As Darling rightly says:

> The physiological effects of training, on the heart and kidneys in particular [and we might add, on the nervous system], may approach unpleasantly near to pathological conditions.

The physiological basis of overtraining is not altogether clear, but the fact of overtraining is undeniable.

Thirdly, physiology teaches that the fatigue of one tissue from over-use means the fatigue of all tissues. Extreme activity of the muscular system involves not only lessened muscular, but also lessened mental activity.

Fourthly, physiology bids us to beware of physical excess. According to Tissié there are three degrees of fatigue—slight fatigue or lassitude, which gives tone to the body; fatigue which irritates, excites and enervates; and fatigue which weakens; and he adds that the two latter degrees of fatigue should be absolutely avoided. With this view I can in general agree, and yet I would not here be an extremist. If I read aright the teachings of physiology, they are that physical exercise, carried to the point at which it produces extreme fatigue, and persisted in, can not fail to be harmful. The human body is, indeed, wonderfully resistant and capable of apparently complete recovery after a considerable degree of abuse. But it is not to be denied that extreme physical exertion is a debauch and, like any other debauch, leaves the individual mentally, morally and physically depleted. It is also not to be denied that the chances of continued well-being are enhanced if the debauch is never indulged in. No sharp line can be drawn between what is normal and what is pathological in fatigue. What is normal for one person may be pathological for another. Training should extend the boundaries of the normal. But it is safest to avoid those physical exercises that force the organism to the border line beyond which the abnormal lies. The one may pull his all in the tug of war or wield his oar in the four-mile race, or run his twenty-five Marathon miles. But it is the physically exceptional man who can do these things, and the physically average

man would best leave them to him who is exceptional. It is the physically average man who does the world's work, and if he becomes physically incapacitated, as he may easily become if he tries to become physically exceptional, not only the individual but the world suffers. It is not only the teaching of physiology, but it is the teaching of common sense to avoid physical excess. Common-sense hygiene should have its place in a liberal education. What a liberal education should do for the individual is so well put by Huxley that I am tempted to quote his words:

> That man has had a liberal education who has been so trained in youth that his body is the ready servant of his will, and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength, and in smooth working order; ready, like a steam engine, to be turned to any kind of work, and spin the gossamers as well as forge the anchors of the mind; whose mind is stored with a knowledge of the great and fundamental truths of nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions are trained to come to heel by a vigorous will, the servant of a tender conscience; who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to respect others as himself.

Physiology tells me that this is the education which we should give to our youth.

Frederic S. Lee

Columbia University

DEPARTMENTAL ORGANIZATION FOR THE REGULATION OF PHYSICAL INSTRUCTION IN SCHOOLS AND COLLEGES FROM THE STANDPOINT OF HYGIENE[1]

Physical instruction or physical education in the past has been handled largely from the standpoint of physical exercise. Gymnastics, or calisthenics, or games, or athletics have constituted the chief and often the only work done in physical instruction in many of our institutions. The word "gymnasium" has been and often is now, synonymous with the words "department of physical education." The objects of physical instruction have been predominantly those attainable through physical exercise. Many of our departments are even now interested mostly in bulk of muscle or in strength, speed, endurance and coordination; or in the development of a winning team or a star athlete; or in the perfection of bilateral symmetry and the production of grace of movement. And so we find the curriculum of the department including only, or chiefly, such individual and class work as may be handled from the standpoint of physical exercise. An anthropometric examination has been a common requirement because it has been assumed that by comparing the individual with the standard, his need for special developmental physical exercise would become apparent. He could then specialize more or less along certain lines of physical exercise and correct his deficiencies in form, symmetry, bulk or strength of muscle. Certain special medical data have been secured frequently because it was found that physical exercise might easily produce a serious effect upon unusually weak organs.

Further, the curriculum always provided some sort of work in physical exercise. This might be applied to the individual or to groups or classes. It consisted of mass drills or apparatus exercises, games, contests, swimming or athletic sports, or combinations of any two or more of these various phases of physical exercise. Special exercise was planned in many cases for those individuals who ap-

[1] An address delivered in a symposium on "The Regulation of Physical Instruction in Schools and Colleges, from the Standpoint of Hygiene," before Section K (Physiology and Experimental Medicine) of the American Association for the Advancement of Science, Baltimore, December 20, 1908.

peared to need special or corrective development.

The instructors selected to handle departmental work have been selected with more or less special reference to the chief objects which the departments might have in view. These objects were in some cases predominantly anthropometric. They were rarely widely hygienic or medical and they were nearly always narrowly hygienic or purely gymnastic or athletic. For these reasons, the special preparation of the instructor in physical instruction has been occasionally medical, occasionally hygienic, rarely physiological, often anthropometric and usually gymnastic and athletic.

As a result of these limitations in departmental scope and staff equipment, the achievements of physical instruction have been restricted to some of the anatomical, physiological, hygienic and psychological effects of exercise; and because of these same limitations, the faults of physical instruction have been numerous and destructive. The instructors have not often been men of academic training or of scientific or of professional training. Such equipment was not asked for, as a rule, and often could not have been paid for had it been offered. With inadequately trained instructors on the one hand—I will not say poorly trained, because many of them were superbly trained for special phases of physical exercise, but not for physical instruction—and on the other hand with the departmental scope limited to one or more phases of physical exercise, it has naturally followed that physical instruction has been judged to be unacademic and that academic men have been reluctant to permit its academic advancement.

Furthermore, these conditions have made collegiate physical instruction appear to be synonymous with gymnastic work, so that the Y. M. C. A. gymnasium, the church gymnasium, the factory gymnasium, the business man's gymnasium and the athletic club, are all classed popularly with the collegiate department and with each other. (It is not my purpose here to discuss relative merits and I must not be construed as deprecating the value of these gymnasiums, particularly those of the Young Men's Christian Association.)

Furthermore, this narrow departmental scope with its consequent limiting effect upon staff equipment, not only makes it impossible for the department to realize the broad health influences which we now believe belong to it, but it increases greatly the chances for physical injury to the individual student or pupil. Without a knowledge based upon a medical examination of the organic condition of the individual, it is impossible to plan his work wisely and safely. Without a sound knowledge of the physiology of exercise—and this includes the major part of all human physiology—it is unsafe to undertake to administer exercise to large groups of boys or men among whom unsuspected anatomical and consequent physiological weakness or abnormality may be present. Clearly, many of our teachers in physical instruction have not been adequately trained for even the relatively narrow field of physical exercise to which physical instruction has so long been confined. And it is no wonder that complaint has arisen from physician, physiologist, hygienist, educator and layman. It is no wonder that concrete examples of medical, hygienic and physiological error may be cited. It is no wonder that positive injury has been done to individuals. It is remarkable, rather, that so little injury has followed in the wake of these conditions.

On the other hand, there have always been thoughtful men in physical education who have held that the chief object

of their work was the development and maintenance of health. "A sound mind in a sound body"—this is an old battle cry—means a healthy mind in a healthy body. Some of our oldest directors have taken this position, though forced by circumstances and by training to rely almost wholly upon physical exercise for the accomplishment of their objects. These men have felt that physical instruction is bigger than physical exercise, and that physical exercise can not alone secure the desired effects on health. They have felt that physical instruction is concerned with physical health; that physical health is fundamental to normal physiological activity, whether that activity be expressed as locomotion, circulation, respiration, digestion, cerebration or any other organic function. We know that the physical health of the human body depends upon the health of the tissue cells of which the human body is composed. The health of these cells depends absolutely upon their nourishment, their exercise, their rest, the proper disposition of their excretions and the other products of their activities, and upon a reasonable freedom from the influence of disease-producing agents. The neglect of any one of the requisites may destroy the good effects of the proper observance of the others. And it follows that the physical health of the human body may be secured and conserved only by the observance of the several fundamental laws that operate in the production of health in the tissue cells. These laws are concerned with nutrition, excretion, exercise, rest, respiration, cleanliness and protection against disease. Their uniform observance means physical health. The neglect of any one law means failure in the effort to secure and conserve health, even though these other laws may have been properly observed. No man may expect good physical condition and consequent health if he sleeps too little, or if he ruins his digestion and thus starves his tissues, or if he takes no exercise, or if he neglects his excretions, or breaks any other of these laws.

With these facts in mind a considerable number of men interested, feel that a department of physical instruction must teach the theory and develop the practise of these several fundamental laws of health in order to approximate the object for which such a department exists. It can not afford to neglect any one of these fundamental laws and it can not afford to overestimate any one of these laws.

We find evidences of this conception of the broad scope of physical instruction in many of our colleges. A year ago in the Society of College Directors of Physical Instruction, there were forty members, of whom thirty-two had academic or professional degrees. These thirty-two men have sixty-one degrees. Less than a year ago at the second congress of the American School Hygiene Association, Meylan, of Columbia University, reported that thirty-one out of thirty-two college departments of physical instruction which replied to his questionnaire were giving courses in hygiene. This means that some of these departments are in the hands of men with academic sympathies, men who are trained medical experts, men who are experienced hygienists; and that these men combine this equipment with that of a practical experience in the technical procedures of gymnasium work. The departments under these men are being organized somewhat as follows: First, all students or pupils are in many places required to undergo a medical examination. The tendency of the modern college and high school is to require this examination of all individuals whether they are planning to go into athletic or gymnastic work or not. In most colleges opportunities for

medical consultation are provided. In some colleges and high schools, frequent medical *inspections* are required. On the basis of these examinations, inspections and consultations, the school life and departmental activities of the individual are regulated. This influence goes so far in some instances as to debar the individual from attendance because of his physical condition. In any event, his physical exercise is planned in conformity with these medical findings, so that the possibility of injury to weak organs through excess exercise influences is greatly minimized.

Second: A hygienic and sanitary supervision is exercised in some institutions. This supervision is closely related to the medical supervision. In fact, they can not be separated entirely. This combined supervision, medical and hygienic, regulates the physical exercise applied in the department. It selects and grades the drills and exercises in the various courses with reference to desirable physiological, anatomical and mental effect. It plans the special work for the special cases with special reference to the conditions that are found on medical examination. Further, it enforces a practical application of hygiene and sanitation throughout the department and often throughout the other departments of the high school or college. Such a supervision can and does enforce bodily cleanliness in the exercising hall; enforces clean gymnasium suits and towels; and enforces regulations relative to spitting and other nuisances in locker rooms, hallways and corridors; and regulates the sanitation of the toilet rooms, shower baths, swimming pool and so on. Pupils and students whose personal hygiene is obnoxious may be required either to improve their hygiene or leave the institution. This influence may easily extend to secure an improvement of the student's home surroundings, because his own hygiene can hardly surpass that of his environment.

It can be easily seen that this medical and hygienic supervision secures: first, protection from contagion; second, discovery of and expert advice concerning remediable physical defects; third, regulation of exercise in conformity with the organic limitations of the individual; fourth, the application of the laws of hygiene and sanitation to the individual and his institutional surroundings; fifth, a habituation to hygienic practises which is likely to influence the individual and through him his surroundings for the remainder of his existence.

A third phase of this modern departmental organization provides for instruction concerning the simple fundamental laws of human health. Personal hygiene, general hygiene and sanitation are being taught in these departments. Courses are given on such subjects as "Ways and Means of Securing and Conserving Health," "The Influence of Common Abnormalities and Habits of Health," "The Causes of Diseases," "Carriers of Disease," "Defenses against Diseases" and "The Nature of Some Common Diseases." These courses teach some of the main facts of nutrition, exercise, rest, excretion, bathing and disease, so that young men may carry away an intelligent policy of personal health control.

The fourth division of departmental organization is that which provides instruction in the various phases of physical exercise, including mass drills, apparatus exercises, swimming, and indoor and out-of-door games, sports and play. This work is being carefully graded. It is taught with direct reference to its influence on the health and character of the individual and therefore with a close adherence to the laws of physiology, hygiene, psychology and medicine as we now understand them.

Mass of muscles, strength, speed, endurance and coordination are secured incidentally. They are indeed often desirable, but are not the main objects of such work. These various phases of physical exercise are planned with reference to their primary influence on tissue health and their inevitable secondary influence on functional efficiency, such as voluntary muscular contraction, circulation, respiration, digestion, assimilation and cerebration. They do their heavy share of the work necessary in order to turn out men of health, men of courage, men of self-reliance, men of self-respect, men who think on their feet and act on their thoughts, and men who have learned the value of combined effort and the subordination of the individual interest to that of the group.

As an example of departmental organization in these four phases of physical instruction, permit me to cite a department that has come under my close observation. This department is in a college in which the combined academic and collegiate attendance reaches about four thousand. The department of physical instruction there is given a medical and hygienic supervision over the entire student body. A medical examination is required of all entering academic and collegiate students. The medical inspections are required each half year of all academic pupils and of all freshmen and sophomores. Medical consultations are open to all students on their own volition or on request of their instructors. All candidates for athletic teams undergo a special medical examination before admission to competition or training. Upon recommendation from the department, all students whose physical condition is a menace to their companions are debarred from attendance until the complaint is removed. All students whose physical condition requires it, are given special exercise during the terms in which they are required to attend classes in the department.

A special hygienic and sanitary supervision is exercised over the students in the department and over the departmental building and all of its subdivisions.

Instruction in hygiene is given in six courses to each of the six classes that are required to take work in the department. These courses cover "The Ways and Means of Securing and Conserving Health," first term; "The Influence of Certain Abnormalities on Health," second term; "Some of the Causes of Disease," third term; "The Carriers of Disease," fourth term; "Defenses against Disease," fifth term; and "The Nature of Some Common Diseases," sixth term.

Instruction in physical exercise is given to these six classes. The mass drills are carefully graded throughout the six terms. The apparatus work is graded during the last four terms required in the department, that is, during the freshman and sophomore years. Graded requirements in swimming are in operation in each of the courses in the department and are classified under "Apparatus Work." No out-of-door work is provided, so that this seriously important phase of exercise is neglected. Certain games are taught in the department.

A typical class hour is divided as follows: first period, floor talk on health; second period, mass drill; third period, apparatus work.

Written examinations and practical tests are required every month and final written and practical examinations are applied each term. The records of these examinations are filed with those from the other departments with the secretary of the faculty as term and final examination marks; credits are given for the work.

Let me summarize the main points of my paper as follows: First: Physical instruction has been handled largely from the

standpoint of physical exercise; this standpoint has limited the scope of the department to the possibilities that lie within the range of physical exercise. It has restricted the preparation required of teachers of physical instruction to those subjects or experiences bearing on some one or more phases of physical exercise, and it has made possible and deserved many criticisms because of its unacademic character and its opportunities for the commission of injury to individuals.

Second: There have always been a few directors of physical instruction who feel that their field of work is larger than that of physical exercise, and that it is concerned with human health.

Third: Physical instruction is now being handled more and more from the standpoint of human health. This point of view broadens the scope of the department so that it includes medical, sanitary and hygienic supervision and instruction concerning the simple fundamental laws of health and the various phases of physical exercise. This broader departmental scope necessitates the employment of experts upon the staff whose special training has fitted them for medical, hygienic and sanitary supervision and instruction as for instruction in the various and important phases of gymnasium and athletic work.

In conclusion, gentlemen, permit me to state that we who are interested in these tendencies in physical instruction believe they are tendencies in the right direction. We believe that our professional and pedagogical aim has in view the achievement and conservation of human health through the regulation of physical instruction from the standpoint of hygiene. We believe that this broad field belongs logically to us. We believe that if we can develop and conserve health in human beings, and teach them how to exercise an intelligent policy of personal health control, we shall have utilized whatever special scientific, medical, hygienic and pedagogical training we may have, for the best interests of humanity of which we are a part and of the world in which we live.

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THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING

THE annual reports of President Eliot to the corporation of Harvard University have in certain respects been the most interesting educational documents of past years; their place will now be taken by the reports of President Pritchett of the Carnegie Foundation. In these reports and in the intervening bulletins, there are not only given lucid and complete accounts of the activities of an institution of vast importance for higher education, but also careful studies of the educational system of the country. In this respect the foundation sets an example to the General Education Board, which keeps for its private use the information that it collects, and does not even publish the financial statements that should be required by law from every corporation, and first of all from those exempted from taxation.

President Pritchett's third annual report, which covers the year ending September 30, 1908, shows that the new grants made during the year amounted to $113,765. The grants in force amounted to $303,505, an increase of $101,360 over the preceding year. Should this increase continue for two further years, the income of the foundation would be exhausted. The retiring allowances in force were: On basis of age, 86; on basis of length of service, 81; for disability, 15; to widows of professors, 29. The average age of those retired for length of service is 65.7 years, so that it would appear that more than half of them are entitled to retirement for age. The aver-

age value of the retiring allowances is $1,522.56. The institutions drawing the largest sums are: Yale, $25,195; Cornell, $16,670; Harvard, $16,305; Tulane, $14,365; Columbia, $14,055; Stevens, $11,075.

Valuable data are given in the report in regard to institutions on the accepted list and the state universities, together with a discussion of political interference in tax-supported institutions with special reference to the University of Oklahoma. Other topics treated are: the exchange of teachers between Prussia and the United States; uniformity in financial reports; teachers' insurance; college requirements for admission; special students; amount of instruction given by teachers; professional education; denominational education.

The foundation adopted during the year two new policies of great importance—one the admission of tax-supported institutions for the cost of which Mr. Carnegie has undertaken to give $5,000,000, the other the provision that a widow shall receive half the pension to which her husband would have been entitled.

There is no valid reason why the states should not accept a gift from Mr. Carnegie for their universities. In so far as the money came originally from the people, and especially from the agricultural regions of the central and western states, through the workings of the tariff, this was imposed by the representatives of the states, and the best use of the money is to return it to those from whom it was taken. Nor is the fact that the fund is in the form of bonds of the United States Steel Corporation significant. All our universities hold bonds of railway and other corporations whose activities have not always been beyond reproach.

The real questions are whether a centralized pension fund is for the advantage of our universities, and, if so, whether a fund can be provided sufficiently large for the purpose. The writer dissents from most of his colleagues in doubting the desirability of a uniform and centrally administered pension fund. I have always been prejudiced against annuities and those who buy annuities; it is distasteful to me to be thrust by force of circumstance into this class. The president of one of our leading universities has stated in a report to the trustees that the annual value of the pension to a professor in middle life is $1,200. I should prefer to have this increase to my salary now when I have children to educate; or, if it could be saved, to have it as capital to be used for such purposes as may be desirable and to be bequeathed to my family. The withholding of part of a professor's salary to be paid ultimately after good behavior in the form of an annuity will tend to increase the autocracy of university administration and to limit not only the freedom of action but also the freedom of speech of the professor. It will also limit the freedom of action of the administration, for a professor can not be dropped honorably when part of his salary has been reserved for a pension. It seems from the decision of the courts in the case of Professor Capps against the University of Chicago that this can not be done legally, and there will probably arise complications which have not been fully foreseen.

It is not intended to imply that the office of the professor should be subject to the commercial law of supply and demand. On the contrary, he should have life tenure, only forfeited by the violation on his part of the conditions implied in accepting the office. It would be intolerable if a professor could be dismissed simply because the president thinks that he might obtain a more acceptable man in his place for the same or a smaller salary. The professor is appointed at the average age of nearly forty years and is likely to remain what he

then is; if an unwise appointment has been made, the institution should accept the responsibility.

Permanent tenure of office doubtless implies a continuation of salary or a pension in case the professor can no longer serve *to advantage*; and this leaves the difficulty resulting from paying a professor less than he is worth in middle life in order that he may receive more than he is worth in old age. Obviously we must face this situation; but it is emphasized and made worse by the establishment of a uniform and centralized system of pensions. It can be most conveniently met if we are sufficiently optimistic to assume that on the average the services of professors over sixty-five years of age are worth to their institutions and to the community the salaries that had previously been paid. A professor at this age may become a less efficient teacher in professional and required courses, though this is not always the case. It is, however, by no means certain that he is, on the average, a less desirable teacher in advanced and elective courses; or that his scholarship, experience, judgment and poise are not of the utmost advantage to the university. A man of this age may not have new ideas; but his research work and productive scholarship are likely to continue and to be of greater value to the world than the salary he is paid.

The teachers who have had the greatest influence on the writer are Professor March, of Lafayette College, and Professor Wundt, of Leipzig. Professor March ceased to teach recently at the age of over eighty years and Professor Wundt continues to lecture regularly at the age of seventy-five years. It would have been a serious loss if these great men had ceased to teach at the age of sixty or sixty-five. If I were now beginning the study of psychology, I should wish to spend a year under Professor Wundt at Leipzig and a year under Professor James at Harvard. I should be able to work under Professor Wundt, but should find that Professor James had been retired on a Carnegie pension in the fullness of intellectual vigor. If Mr. Angell can to advantage serve as president of Michigan to the age of eighty and Mr. Eliot can serve as president of Harvard to the age of seventy-five and still retain the chairmanship of the trustees of the Carnegie Foundation, we have evidence that a dead line can not be drawn at sixty-five.

The institutions accepting the terms of the Carnegie Foundation for pensions on the basis of age must make retirement on a pension at sixty-five mandatory, or else they must make it a matter of arrangement between the administration and the professor. Either alternative is unfortunate. If the retirement is mandatory, the institution will lose men whom it can not afford to lose, and professors will be retired who are competent and anxious to continue their work. It will be a poor reward in the academic career to cut men off from the service of their lives and pay them part salary, when in other professions at that age they would probably have continued to be leaders and to have had an income at least twice as large as twenty years before. If the retirement is only permissory an institution might gain temporarily by retiring its less efficient men; but this would be only a mitigated form of the policy of dismissing professors whenever their places can be filled at less cost. Every institution could improve for a time its faculties by dismissing twenty per cent. of its professors; but such an undertaking would in the end be disastrous to the institution and to higher education. If only incompetent professors and those not in favor with the administration are retired at sixty-five, the pension will be far from an honor and by no means a worthy close

to an academic career. It will frighten able men from it at the outset, and tempt them to desert it when they can.

It may give a sense of security to be assured of a pension in old age; but when the time comes the reduced salary will cause difficulty to those not having independent means. There will be a tendency for the professor to engage in some form of money-making and to begin early in his career. An eminent man of science has written to me that since he had been retired on a Carnegie pension he could no longer contribute to a scientific journal, as he had to earn a living for his family by writing fiction. The community and the world are largely dependent on the university professor for the advancement of science and scholarship and for the maintenance of the best ideals, and those great services are not paid for directly. They can only be assured by attracting the best men to university chairs and then setting them free to do their work with no interference and no fear of dismissal even on half salary.

In my opinion the Carnegie Foundation would have been most wisely administered if it had agreed to give to every institution that had adopted or would adopt a half-salary pension after the age of sixty or sixty-five an endowment sufficient to defray the remaining half of the salary, so that the professor would be paid his regular salary for life. He could then retire from the teaching for which he was not fit, but could continue to give his services to his institution and to his science. Or if the allowance had been paid by the foundation directly to the professor without regard to whether or not he continued his teaching, then he could give to his institution so much service as he might render to advantage and in turn receive so much salary as he might earn.

But the trustees of the Carnegie Foundation are presidents, not professors, and the money is to be divided in the main so as to relieve the financial straits of the institutions, not to improve the status of the professors. The professors in those institutions which already had a pension system do not gain financially as far as the old-age scheme is concerned and lose in certain ways; whereas the institution gains the amount it had contracted to pay in pensions. The professor as well as the president is pleased that the university has added resources; but they do not differ from any other unrestricted endowment.

The conditions are different in the case of institutions which did not have a pension system. Here too it is chiefly the institution which gains, for it was bound in honor to provide for its disabled professors, and it will hereafter pay smaller or less increased salaries in view of the pensions.[1] But the presidents and professors have an assurance that they did not have and will have annuities that they did not earn or only partly earned. The advisability of having made the pensions retroactive in this way is questionable. Gifts may be at the same time acceptable and demoralizing. When Tulane University raises nominally its entrance requirements beyond what can be met by the high schools of Louisiana in order that it may be accepted by the foun-

[1] It is not admitted by the officers of the foundation that pensions will tend to prevent increase of salaries; but this appears to be an inevitable result of economic law. In seeking recruits for the army and navy the government states that the small wages are compensated for by the pensions, and one of the state universities has urged that if the legislature does not accept the pensions from the foundation, it will be necessary to pay higher salaries in order to retain its professors. A pension system may or may not improve educational efficiency, and it may or may not improve the general conditions of the academic career; it will not improve permanently the financial status of the professor.

dation, we are not surprised to find that it draws annually $14,365, and when the Central University of Kentucky cuts itself off nominally from its denominational control in order that it may be accepted, we are not surprised to find that three of its eleven professors are immediately placed on the foundation.

It would, I believe, have been far better if the foundation had undertaken to hand over to each institution that had adopted or would adopt a pension system an endowment from the income of which the professors' salaries could have been maintained for life. Even if it were decided to give a pension smaller than the salary, the endowment might with equal advantage be made once for all. The foundation could in this case take up one institution after another and from its income award a fund sufficient to endow a pension scheme in each. Under these circumstances, the income would never be completely tied up, but could always be used in the way most likely to promote the advancement of teaching. The same plan might with great advantage be pursued by the Carnegie Institution of Washington. If instead of attempting to administer from Washington scientific institutions in all parts of the country, it would found and partly endow such institutions, and then leave them to local control and support, the money would go much farther and the dangers of a bureaucracy would be avoided.

The drawbacks of a centralized pension system may be illustrated by an example. A professor has reached the age limit with a salary of $4,000. He prefers to continue his regular teaching and research and can do so competently. If the institution had to continue his salary, it would have no inclination to relieve him of his duties, nor would it care to do so if it had to pay a pension of $2,400, for in this case the $1,600 released would not suffice for the salary of a new professor. But if the payment of the professor's pension can be put off on the Carnegie Foundation, then the president will reflect that he can obtain a new man about equally competent for $3,000. He will thus save $1,000, and the institution will still have credit for the work of the retired professor; the students he attracts; the indirect teaching that a man engaged in research at the university can not fail to do; his valuable judgment and counsel. The institution saves $1,000 and gets $2,400 more that it could not get in any other way. At first sight it may seem that no one suffers except the dismissed professor; but in the end it will be found that the institution and higher education also suffer.

The risks of the system for the professor are increased by the scheme of retirement after twenty-five years of service. Sixteen of the most efficient professors in Harvard University and fifteen in Columbia University are now liable to compulsory retirement apart from age; and owing to the great growth of these universities within the past twenty years, the number of men in this class will increase rapidly. These institutions could take from the Carnegie Foundation about $75,000 a year now by retiring these men and probably two or three times as much a few years hence. If the emeritus professors maintained their interest in the institution and continued their research work, the university would apparently lose but little in return for the great financial gain. But the professors would suffer, and ultimately the whole academic life would be demoralized.

The reasons leading to the adoption of retirement after twenty-five years of service are obscure to me, unless it is intended to relieve institutions of men whom they do not want to keep. Some few professors having independent means or outside employment may like to retire on half salary;

but these are exactly those who do not need pensions. Any who may be disabled after twenty-five years of service and before reaching the age-limit gain; they are, however, but few and should be otherwise provided for. It appears to be a mistake to hold up retirement from the life-work of a professor as a prize or reward. The usual professor can not afford to retire unless he engages in money-making, and the plan will thus lead to commercialism and the discouragement of research. He is permitted by the rules to do anything except teach—that for which he should be most competent and that which he should most enjoy. Research work and advanced teaching can be carried on far better in conjunction than divorced. In order to reward a professor after long years of service, he should be relieved, not of half of his salary and the privilege of teaching, but of so much routine instruction and administration as interfere with his research. This is now done in our better universities; professors of distinction who wish to devote themselves mainly to advanced students and research work are encouraged to do so.

There is a minor difficulty in the way of retirement—whether it is to be a reward or a punishment—after twenty-five years of service as professor in that it is impossible to date fairly the beginning of such service. In every university some professors between the ages of fifty and sixty-five will be liable to retirement on the basis of age and others not, but there will be no significant difference in the work that has been accomplished for education and scholarship by the two classes. According to the circumstances of the case, it will be an advantage or a risk to have been given the title of professor at an early age in a small institution. It may on the whole be regarded as fortunate that the Carnegie Foundation has not the means to continue these annuities for length of service. They will, I fear, tend to demoralize both the "humble and ill-compensated" professor and the "conspicuous" and much-tempted president.

A very useful service that the Carnegie Foundation could perform for the professor and for academic life would be some form of pension for disability, as this can not be purchased. Another useful service would be the pensioning of widows and minor children. Personally, I should prefer to let the professor purchase voluntarily at cost the disability annuity and the life insurance; but I am instinctively an extreme individualist. Certainly the pensioning of the widows of professors entitled to pensions by statute instead of by favor is a notable advance made by the foundation last year. The enforced pensioning of widows is even more socialistic than the enforced purchase of annuities; for ultimately the unmarried professors will be compelled to pay part of the premiums on behalf of their more fortunate colleagues. But it may be that people who bring up children deserve more from the world; certainly those who have only the annual income which they earn for those dependent on them should insure their lives, and perhaps they should be compelled to do so. The weakness of the system of the Carnegie Foundation is that it applies only where it is least needed. It is the instructor or junior professor with young children, having had no chance to save, who finds it hard to pay an insurance premium and sometimes neglects it.

It is not clear to the writer how it was estimated that a fund of five million dollars would provide pensions for the state universities and colleges. The demands on the foundation will depend on whether retirement is mandatory or whether it ordinarily follows only on disablement. At Harvard University there are at present seven professors on the retired list, two widows re-

ceive pensions, and the cost to the foundation is $16,305. There are twenty-eight other professors now eligible to receive allowances. Should they be compelled to retire or wish to do so, the total charge of Harvard University on the foundation would be about $75,000.

Even with a stationary number of professors and stationary salaries, there are two circumstances which will add greatly to the cost of the system. One of these is the "age distribution of the population," a factor which the trustees of the foundation may not have considered, as it appears to have been completely overlooked by both advocates and opponents of the old-age pensions in Great Britain. The population of that country, through a high birth rate from 1850 to 1900, has increased greatly since the middle of the last century, and the people form a youthful population. There are probably two to three times as many people over seventy years of age per thousand of the population in France, with its stationary population, as in Great Britain. The British chancellor of the exchequer will be awakened to the apparently unexpected circumstance that the number of those entitled to pensions from the government will be doubled or tripled apart from any increase in population. Similar conditions obtain in our universities which have more than doubled the number of their professors in the course of the past twenty or thirty years. Nearly all those appointed to professorships were young and are now growing old together. In twenty-five years the relative number of professors over sixty-five will probably be doubled or tripled.[2]

The other circumstance that will increase the demands on the funds of the foundation is the pensioning of widows. Professors are nearly or quite as likely as [illegible]e widows, and the expectation of [illegible]ir widows will be nearly or quite [illegible] as their own when eligible for [illegible]ies. Thus the cost of the widows' pensions will ultimately be nearly or quite one fourth the cost of the annuities. It is further to be noted that all widows will receive pensions, even though a considerable proportion of those entitled to annuities do not draw them.

It consequently appears that with the same number of professors and the same salaries as at present, Harvard University would after a few years be able to take from the foundation at least $150,000 a year in annuities and at least $35,000 in widows' pensions. How much would actually be taken for annuities would, of course, depend on whether or not retirement were mandatory or generally adopted.

The number of professors will not remain stationary, nor will salaries remain stationary. Harvard has about doubled in size in the past twenty years and quadrupled in size in the past forty years. Even should this rate of growth not continue at Harvard, it will, I believe, be maintained on the average and will be exceeded in the state universities. Harvard and Columbia may in forty years have four

[2] In the faculty of pure science of Columbia University there are fifty-two professors, the ages of forty-seven of whom are given in "American Men of Science." The distribution is:

Age	Number
30–35	4
35–40	8
40–45	12
45–50	9
50–55	9
55–60	1
60–65	3
65–70	0
70–75	1

The median expectation of life of these men is at least twenty-five years, and we may expect that more than one half of the thirty-four now between forty and sixty-five will still be living twenty-five years hence. In the place of one man over sixty-five years of age and eligible to be pensioned for age (there is now none retired on a pension), there will be seventeen.

times as many professors as they now have; Michigan, Illinois, Wisconsin and the other state universities will almost surely have four times as many. It is a modest hope that salaries will increase fifty per cent. The cost in a great university of a pension system such as that of the Carnegie Foundation, if all retire who are eligible, may forty years hence be expected to be in the neighborhood of one million dollars a year. If at that time trust funds bring 3 per cent. interest, it will require $30,000,000 to endow a pension system for a single university; and there will probably be not fewer than twenty such with a hundred others tending to become such.

Forty years hence some two billion dollars may be required to endow completely a centralized pension scheme for North America such as that of the Carnegie Foundation. Nor is this too long to look ahead. Young men of twenty-five, now entering the academic career and accepting smaller salaries in view of a pension at sixty-five, will not be honorably treated should it be withdrawn. Indeed they can possibly recover the pension at law.

The figures given here may seem somewhat appalling; but they are really not so. If pensions are only paid for disability at any period in the lives of university teachers and to their widows and minor orphans —I believe that no other kinds of pensions are desirable—the cost would be much less. It would represent a capital far beyond the possibility of private endowment, but would be a sum not considerable in comparison with the wealth of the country. Twenty times the amount could to advantage be saved each year by a reasonable reduction in the expenditure for alcoholic drinks. The economic gain to the nation and to the world from the research work of university professors far exceeds their salaries and their pensions, even though no account be taken of the value of their teaching or of their contribution to ideal ends. The more scientific men the world supports, the richer will it become, as well as the better. But the nation, the states and the cities must maintain their universities.

J. McKeen Cattell

RECENT STEPS IN THE CONSERVATION MOVEMENT

Soon after the assembling of the Sixty-first Congress in extraordinary session, the Senate created a committee on the conservation of our natural resources, comprising Senators Dixon (chairman), Clark, of Wyoming, Beveridge, Dolliver, Dillingham, Heyburn, Dick and Briggs, of the majority, with Senators Guggenheim, Jones, Newlands, Overman, Davis, Bankhead and Smith, of South Carolina, of the minority. Of this committee, Senators Dixon, Newlands, Dolliver, Bankhead, Beveridge and Overman are members of the National Conservation Commission.

While the Rivers and Harbors Act passed by the Sixtieth Congress made but limited appropriations chiefly for continuation of current work, the provisions for surveys affecting new projects was exceptionally, indeed unprecedentedly, liberal; and specific provision was made for a legislative waterways commission, empowered to carry forward the framing of plans for waterway improvement, and for requisite investigations in this and other countries. This commission has now been organized by the Sixty-first Congress; it comprises Senators Burton (chairman), Gallinger (vice-chairman), Piles, Smith, of Michigan, Simmons and Clarke, of Arkansas, with Representatives Alexander, Lorimer, Stevens, Wanger, Sparkman and Moon, of Tennessee. Senator Burton was for a number of years chairman of the Rivers and Harbors Committee, and is chairman of the Section of Waters of the National Conservation Commission, corresponding to the Inland Waterways Commission.

On March 24 the four national engineering societies (American Society of Civil Engineers, American Institute of Mining Engi-

neers, American Society of Mechanical Engineers and American Institute of Electrical Engineers) held a joint meeting in the Engineering Societies Building in New York City devoted to the conservation of our natural resources. In the absence (due to illness) of Onward Bates, president of the senior society, Dr. James Douglas, president of the Institute of Mining Engineers, presided. Addresses were delivered on behalf of the four organizations on "The Conservation of Water," by John R. Freeman; on "The Conservation of our Natural Resources by Legislation," by Dr. R. W. Raymond; on "The Waste of our Natural Resources by Fire," by Charles Whiting Baker, and on "Electricity and the Conservation of Energy," by Lewis B. Stillwell. In addition to the set addresses, Dr. Douglas outlined in general terms the development of the conservation idea and the important part played by the engineering societies in directing attention to the nature and extent of resources and to the enormous wastes in utilizing them; while John Hays Hammond read a communication addressed to the meeting by President Taft commending its purposes and reiterating his deep interest in the natural resources and their conservation. The meeting was especially notable as marking a definite policy of cooperation on the part of the engineering interests of the country and of the four great national organizations in which these interests find expression. The attendance was large, including a number of engineers and guests from other cities.

W J McGee

SCIENCE BY CABLE

We reproduce the following cablegrams to the daily papers which, in so far as they are correct, are certainly of interest:

London, March 26.—Addressing the Chemical Society yesterday afternoon, Sir William Ramsey announced that he had succeeded in transmuting four different substances into carbon; namely, ziconium, thorium, hydro-lutorsilicic acid and bismuth. Experiments with silver nitrate, with the object of transforming silver in the same manner as copper is transformed into lithium, gave negative results.

Paris, March 23.—The astronomer Gaillot announced before the Academy of Sciences last night that he had discovered two new planets situated beyond Neptune, which is the outermost known planet of the solar system. M. Gaillot stated that he had used the methods which had enabled Leverrier by mathematical calculation to assign to Neptune a position within the boundaries of a certain region, which permitted of its discovery in 1846. M. Gaillot estimated that one of the planets was forty-five times and the other sixty times the distance of the earth from the sun, or 4,185,000,000 and 5,580,000,000 miles respectively. The planet Neptune it is estimated is 2,[illegible] miles from the sun.

Berlin, March 26.—Professor Richard Greeff, of the Berlin University Eye Hospital, announced the discovery of the germ of trachoma. The finding of this germ resulted from experiments with apes conducted with funds supplied by the German government.

SCIENTIFIC NOTES AND NEWS

The return of Lieutenant Ernest H. Shackleton, of the British navy, from his Antarctic explorations and his remarkable results in reaching a point within a hundred miles of the South Pole, in reaching the magnetic pole, in ascending Mt. Erebus and in making discoveries of importance in many directions, were announced in the daily papers of March 24.

Dr. E. Pflüger, professor of physiology at Bonn, has been awarded the gold medal for art and science by the German emperor, on the occasion of the celebration of the fiftieth anniversary of his appointment to the full professorship.

Dr. Albrecht Penck, professor of geography at Berlin, has been elected an honorary member of the Geographical Society at Rome.

Mr. B. E. Dahlgren, formerly modeler at the American Museum of Natural History, New York, has been appointed modeler to the botanical department of the Field Museum of Natural History, Chicago. Mr. Dahlgren is now in Jamaica making studies for the reproduction of a series of tropical plants representative of structural characteristics as well as economic use.

THE *Naturwissentschaftliche Rundschau* announces that Dr. J. Königsberger, associate professor of theoretical physics at Freiberg, has accepted a position in the Geophysical Laboratory of the Carnegie Institution of Washington.

DR. P. RENNER has been appointed curator of the cryptogamic herbarium at Munich.

RECENT foreign visitors at the Bureau of Plant Industry, Washington, have been Professor Vittorio Peglion, of the University of Bologna, Italy; Sr. Don Romulo Escobar, president of the Agricultural College of Chihuahua, Mexico; Mr. Joseph A. Rosen, chief of the Agricultural Bureau of the Governmental Zemstvo of Ekaterinoslov, Russia.

PROFESSOR PAUL HANUS, of Harvard University, was elected president of the National Society of College Teachers of Education, at the recent annual meeting in Chicago.

DR. JAN BOSSCHA, professor of physics at the Delft Technical School and secretary of the Dutch Academy of Sciences, has retired from active service.

DR. HAVEN METCALF, of the Bureau of Plant Industry, returned recently from an extensive trip in northern Italy, where he was engaged in collecting varieties of rice resistant to the disease *brusone*, which he demonstrated to be identical with the blast of rice in America.

DR. FREDERIK VAN EEDEN, of Amsterdam, gave two lectures on March 24 at the University of Wisconsin, on "The Mission of the Poet" and "The Mind in Health and Disease."

PROFESSOR W. E. CASTLE, of Harvard University, delivered a lecture on "Heredity," at the New Hampshire College of Agriculture and Mechanic Arts on March 1.

THE Colorado Chapter of the Society of the Sigma Xi held a banquet on the evening of March 19, after which Professor F. W. Traphagen, of Columbia Chapter, now professor of metallurgy and assaying in the Colorado School of Mines at Golden, read a paper on "Expert Testimony."

PROFESSOR JOHN M. COULTER, of the University of Chicago, addressed the Botanical Society of Washington on Friday evening, February 12, on "Evolution in Gymnosperms." On March 25 Professor Herbert J. Webber, of Cornell University, read a paper before the society entitled, "Is There a Cumulative Action of Selection?"

THE first course of lectures on the Hitchcock Foundation, which provides for a series of scientific lectures to be delivered annually at the University of California, has just been finished by Professor Julius Stieglitz, of the University of Chicago, on the general subjects of ionization and catalysis. The titles of the lectures were: (1) "The Theories of Solution"; (2) "The Theory of Ionization and Electric Phenomena"; (3), (4) and (5) "Theory of Ionization and Chemical Phenomena," including salt formation, etc.; (6) "Complex Ions"; (7) and (8) "The Electric Theory of Oxidation and Reduction"; (9) and (10) "Catalysis." Professor Stieglitz's lectures were attended by 200 to 300 people, including a number of chemists from the surrounding cities.

THE centenary of the birth of Oliver Wendell Holmes will be celebrated at Harvard University, where he was professor of anatomy and physiology from 1847 to 1882, in Sanders Theater on April 27. President Eliot will preside, and brief addresses will be made by Dr. Edward Waldo Emerson, of Concord, by Col. Thomas Wentworth Higginson, by Dr. David Williams Cheever, and by Rev. Samuel M. Crothers, D.D.

THE committee in charge of a fund for a memorial to the late Dr. Andrew J. McCosh announces that more than $100,000 has been subscribed. The fund will be devoted to some portion of the new buildings of the Presbyterian Hospital, with the surgical service of which Dr. McCosh was identified.

WE learn from the *Bulletin* of the American Mathematical Society that at the Vienna meeting of the *Astronomische Gesellschaft* it was voted to solicit funds for the erection of a Gauss tower on Hohenhagen, the highest mountain near Göttingen, at the vertex of the Brocken-Göttingen-Hohenhagen triangle with which Gauss experimented con-

cerning non-Euclidean geometry. Ten thousand Marks have already been received. It is desired that this sum may be sufficiently increased to warrant the laying of the corner stone on April 30, 1909, the birthday of Gauss. Contributions may be sent to Professor F. Klein, Göttingen.

William Henry Wahl, author of various contributions to technical science and for twenty-five years secretary of the Franklin Institute, Philadelphia, died on March 23, at the age of sixty years.

Dr. George Lorimer Baker, of Dorchester, Mass., died on March 19, at East Bridgewater, from tuberculosis which he contracted three years ago while experimenting with its bacilli.

Captain F. H. Hardy died at Aden on March 8 of sleeping sickness, on the voyage home from Nyasaland, where he had been engaged in scientific research into the causes of tropical diseases.

Dr. James Hutchinson Stirling, the veteran Scottish philosopher, died on March 19, in his eighty-eighth year.

The death is announced of Mr. Thomas Wakley, editor of the *Lancet*, at the age of fifty-eight years. He was the only son of Mr. Thomas Henry Wakley, the late editor of the journal, and a grandson of Thomas Wakley, who founded the *Lancet* in 1823.

Dr. Emil Aschkinass, docent for physics at Berlin, died on March 1 at the age of thirty-six years.

Professor H. McE. Knower, librarian of the Marine Biological Laboratory at Woods Hole, requests us to state that the collection of reprints in the library of the laboratory is very much in need of additions. Publications on the various aspects of biology are in constant demand there. Authors are, therefore, requested to send copies of their publications to this library, where they will be particularly useful.

Among numerous charitable bequests in the will of the late Mrs. Emma D. Cummings, of New York, is one of $25,000 to the pathological laboratory of St. Luke's Hospital.

A collection of mosses and hepatics has been received by the department of biology of Princeton University from Dr. Per Dusén and Dr. Hj. Möller, of Falun, Sweden. The collection consists of about ten thousand specimens, one half of which are Scandinavian.

The addition to the Hygienic Laboratory of the U. S. Public Health Service, for which the congress some time ago appropriated $75,000, has just been completed. The addition will be occupied by the divisions of zoology, pharmacology and chemistry and by the library. The original building will be devoted entirely to the division of pathology and bacteriology. Among the more important of the new lines of work recently undertaken in the laboratory is the institution of the treatment of rabies by the Pasteur method and work in connection with the United States Pharmacopœia. The latest publication from the laboratory (Bulletin 47) is from the division of pharmacology and is entitled "Studies on Thyroid. 1. The Relation of Iodine to the Physiological Activity of Thyroid Preparations," by Drs. Reid Hunt and Atherton Seidell.

The Utah legislature has recently passed a law establishing the Utah Engineering Experiment Station in connection with the State School of Mines, the official name of the engineering college of the University of Utah. The station staff is to be made up of the professors of engineering. And the station is "authorized to carry on experiments and investigations pertaining to any and all questions and problems that admit of laboratory methods of study and the solution of which would tend to benefit the industrial interests of the state, or would be for the public good." The regents of the university will organize the station staff immediately, and the first bulletin under the authority of the station will be published in May. It will give the results of an exhaustive study of the cements on the Utah market.

The New Zealand correspondent of the London *Times* reports that the Ngauruhoe volcano, which has been quiescent for a year, is now in violent eruption, sending a column of steam, smoke and ashes to a height of 8,000 feet above the crater. The sun for a time

was obscured, and the country is covered with a thin coating of volcanic dust. At Wanganui, some sixty miles distant, a thick haze overhangs the town, and the air is distinctly sulphurous. Violent explosions and rumblings have been heard many miles away.

UNIVERSITY AND EDUCATIONAL NEWS

A BILL now before the Pennsylvania legislature provides for the appropriation of $950,000 to the University of Pennsylvania, $475,000 for each of the two years beginning June 1, 1909, and June 1, 1910, the money to be used for: hospital maintenance; new hospital building; the continuation of the new veterinary building; the maintenance of the new veterinary building; maintenance of the general university; increase of the library, and a new building for the department of architecture.

THE Hall of Engineering of Northwestern University, given by Mrs. G. F. Swift and Mr. E. F. Swift, at a cost of $100,000, was opened on March 24. It will be remembered that Mr. John F. Hayford, of the U. S. Coast and Geodetic Survey, has accepted the directorship of the new school of engineering.

MR. FREDERICK W. VANDERBILT, in addition to his recent gift of a dwelling house for the use of the Sheffield Scientific School of Yale University, has purchased an adjacent house for $50,000 for the school. With the sale of these two houses the entire square bounded by Wall, College, Grove and Temple streets, with the exception of the building of the New Haven Colony Historical Society and the house on the corner of Grove and Temple streets, in which Noah Webster wrote his dictionary, has passed into the hands of the Sheffield Scientific School.

A HONG-KONG Chinaman residing at Saigon has offered to contribute $4,000 to the university endowment fund, and he also undertakes to raise $40,000 among his compatriots in Saigon.

FOR the purpose of founding a Capper Pass chair of chemistry at Britol University Mr. W. Capper Pass, son of the late Mr. Alfred Capper Pass, who was a member of the council of Bristol University College, has increased his subscription of £4,000 to £10,000.

A CONFERENCE of the deans of the colleges of liberal arts in state universities of the middle west was held at the University of Wisconsin on March 25. Dean Olin Templin, of the college of liberal arts and sciences at the University of Kansas, who is chairman of the meeting, announced a program of four papers to be presented for discussion, as follows: "Method of Grading," by Dean John C. Jones, of the University of Missouri; "Student Organizations," by Dean L. G. Weld, of the University of Iowa; "The Relation of the College to the Other Schools of the University," by Dean Evart B. Greene, of the University of Illinois, and "Advanced Standing," by Dean J. O. Read, University of Michigan.

THE department of engineering of Colorado College will conduct a summer school of surveying at Manitou Park, elevation 7,500 feet, for four weeks beginning June 7. Professor T. B. Sears, of the department of civil engineering at the University of Nebraska, has been chosen director. Several cottages are available for the school and tents are being erected for the accommodation of the students. Manitou Park is on the reserve of the Colorado School of Forestry, twenty miles west of Colorado Springs.

DR. J. H. KASTLE, for the past three years chief of the division of chemistry, of the Hygiene Laboratory, Washington, D. C., has been elected professor of chemistry in the University of Virginia.

M. PERROT, of the Observatory at Meudon, has been appointed professor of physics in the Paris Polytechnic School to succeed M. Becquerel.

M. CAULLERY has been appointed professor of zoology at Paris to succeed the late M. Giard.

DISCUSSION AND CORRESPONDENCE

AMERICAN CHEMICAL HISTORY AND BIOGRAPHY

TO THE EDITOR OF SCIENCE: Having been appointed historian of the American Chemical Society and having arranged for the care of its documents by the Smithsonian Institution, I

earnestly request chemists throughout the country to send to me for safe-keeping in the Smithsonian Institution such historical and biographical documents of American chemical history and biography as they may be willing to part with. They will be kept together, catalogued and be easily accessible to chemists, students and other proper persons. Just at present papers by the late Dr. Wolcott Gibbs are particularly desired. Questions of precedence and patent questions may be decided by such a concentration of documents in a single accessible place. Please address them to The Smithsonian Institution, Washington, D. C., care of Dr. Alfred Tuckerman.

ALFRED TUCKERMAN

NOTES ON FISHES AT CORSON'S INLET, NEW JERSEY

On March 1, 1909, in company with my friend, Dr. R. J. Phillips, the salt-ponds on the meadows at this locality were examined for small fishes. We were rewarded by securing three fine examples of the rare *Fundulus luciæ*, a small cyprinodont described from the Great Egg Harbor region by Baird in 1854. As this is the first definite instance of its occurrence in New Jersey waters since that time I have thought it well worthy of record. Dr. T. H. Bean visited the region of the type locality in 1887 and after a careful search failed to locate the fish. The rediscovery of the species was made by Dr. H. M. Smith in the lower Potomac River in 1890, and was based on two small specimens. Baird's types were not then believed to be extant. Our specimens were found associated with numerous small amphipod crustaceae, *Crangon vulgaris*, numbers of *Palæmonetes vulgaris*, small transparent *Anguilla chrisypa*, numerous *F. heteroclitus macrolepidotus* of all ages, many *Lucania parva*, great numbers of *Cyprinodon variegatus* and a single example of *Menidia beryllina cerea*. Dr. Phillips picked up a fine example of *Gobiosoma bosci* on the beach, and on February 15 he secured in a rain-pool on the barrier beach a number of specimens of *Gasterosteus aculeatus* and one of *Pygosteus pungitius*, the latter being the most southern record on the New Jersey coast we know of. Quite a number of *Pseudopleuronectes americanus* were reported by the fishermen recently, and *Ammodytes americanus* was several times noted during the past winter.

HENRY W. FOWLER

ACADEMY OF NATURAL SCIENCES,
PHILADELPHIA,
March 6, 1909

SCIENTIFIC BOOKS

The Mechanical Engineering of Steam Power Plants. By DR. F. R. HUTTON, Professor Emeritus, Mechanical Engineering, Columbia University. Third edition. John Wiley & Son.

The first edition of this work appeared in 1897 and it has become a standard work of reference in its class. The third revised edition contains some changes in arrangement of topics and material which brings the work up to date. In the last edition the steam turbine is fully described and its advantages, as compared with the piston engine, thoroughly discussed.

There are various technical works which relate to specific machines required for the generation of steam power, but only a few which are devoted to the installation and arrangement of these various machines so as to produce the most economic result, which is the branch of engineering to be considered in the design and installation of the machinery for a complete power plant. The modern power plant involves such a large variety of machinery that its construction constitutes a complicated problem, and it is necessary for the designer to be thoroughly acquainted with the various types of machines and the different varieties of each in order to make an aggregation, of which all the parts will co-act and perform their functions so as to produce the highest economic results. It is obvious that a steam power plant must contain "steam-making" machinery, "steam-using" machinery and the various elements required for transmitting the steam from where it is generated to where it is usefully applied. A knowledge of the industries of this country reveals numerous manufacturers engaged in the production of different vari-

eties of these elements, each of which has special merits for certain conditions and is utterly unsuited for others. In addition to the principal elements above enumerated each power plant must contain various accessory machines, as for instance, pumping installations for feed water, condensers, etc., and under certain conditions it is economical and desirable to supply various appliances for regenerating or saving heat which would otherwise be wasted, such as feed water heaters, economizers and coverings for pipes. When it is further considered that there are several special manufacturers for each of the minor kind of machines, one can readily understand that the field, which is open to Dr. Hutton, is a very extensive one.

In Dr. Hutton's treatment of the problem a full description has been given of the principal forms of boilers, various boiler accessories, furnaces, chimneys and setting, also systems of piping and the accessories for the removal of water and oil.

The principal portion of the work is devoted to "steam-using" machinery and its accessories. In this part full descriptions are given of the principal forms of piston engine and steam turbines, and also a discussion of the theory of action of these machines. The pumping machinery, condensers, construction of foundations, are also thoroughly considered.

The book contains 825 pages and nearly 700 illustrations.

The reader of the work is quite likely to regret that so much space is given to the description and theory of various elements of the power plant, all of which matter can be readily found in special treatises which find a place in practically every mechanical engineer's library, and on the other hand, that so little space is given to the proportioning and coordination of the various elements with each other and to the practical commercial problems which must be worked out in connection with the erection of every plant.

On the whole the book will prove useful to any one engaged in the study of the problem of supplying machinery for the production of power.

Professor Hutton states in his preface that the object of the book is largely the study of "function and purpose of power plant apparatus," and from that standpoint the book is certainly a successful treatise.

What Professor Hutton states respecting the future displacement of the piston steam engine by the steam turbine is doubtless true and is, I believe, of general interest. He states in effect in his preface that the steam turbine has a special field which is limited in a large measure to large units and to the use of electrical transmission and that the piston engine will always be superior for smaller units, and where a large starting torque is necessary, and he also could have added where a vacuum is not possible.

The question has often been raised by the public and investors as to the possible displacement of steam machinery by the internal combustion or gas engine. Dr. Hutton shows that such displacement is not probable, for although the thermal efficiency is higher in the internal combustion engine than in the steam engine, the cost of fuel per unit is generally greater and the repairs and maintenance are much higher. It is not probable that the internal combustion engine will ever replace the steam engine where large power units are necessary. The principal field of the internal combustion engine is that where small powers are required and where the prices of fuel per unit, labor or repairs would be offset by the extra amount of fuel or complications of a steam plant.

R. C. CARPENTER

CORNELL UNIVERSITY

An Introduction to Electricity. By BRUNO KOLBE. Being a translation of the second German edition (1904–5) by JOSEPH SKELLON. Cloth, 8vo, pp. viii + 430. Philadelphia, J. B. Lippincott Co.; London, Kegan Paul, Trench Trübner & Co. 1908.

This book is written in the form of lectures to a class of beginners with little preparation in either mathematics or mechanics. It begins with the electrification of amber, the oldest experiment known to electrical science,

and ends with a brief description of radioactive phenomena. This, together with interesting historical and practical matter, is contained in an appendix. The main body of the work is almost entirely taken up with the older and more fundamental portions of the pure science and some of its most important applications. The lectures are illustrated with abundant, but not too numerous, experiments, most of which are both excellent in themselves and described in a clear and interesting way. Many would do well to follow the author in his extensive use of the gold leaf, or aluminium leaf, electroscope provided with a scale; in discarding the torsion balance for a more modern instrument; in the use of amber as an insulator; and in the use of a straight wire sliding on metal rods across a magnetic field to show the motional electromotive force—all of which are fortunately becoming more and more common. The general plan of the work is good. Its style, though ordinarily clear, is marred by many obscurities and other infelicities of expression, many of them due to clumsiness of translation. Perhaps the most obscure paragraph in the book is that in which the action of the Holtz machine is explained. The author is particularly unhappy in the character and extent of his nomenclature for potential and fall of potential, *some* of his names for these quantities being electroscopic state, degree of electroscopic state, degree of electrification (even when the point whose potential is referred to is not on an electrified body), degree of electricity, intensity of electric field, measure of the degree of electrification in units of work, fall of electricity, fall of potential, polar difference, fall of the stream. This, however, is much the worst case of the kind that occurs. We read that a hollow metal ball can absorb electricity, that electricity is a puzzling force, that electric forces act on each other, of the conversion of electricity into work, and *vice versa;* and we find many other expressions entirely out of place in a work aiming to be scientific, and very objectionable anywhere else. The author wisely devotes but slight attention to the consideration of hypotheses; and fortunately, as it seems to the reviewer, for his treatment of several at least of those taken up appears far from sound. It is a more serious matter that the book is in error as to many matters of fact and theory too well established to question. Thus, for example, a very curious and erroneous explanation is given of the action of flames in discharging electrified bodies. Electric absorption is explained by the statement that the spark discharge takes place so quickly that all the electricity can not follow and a residuum remains. The influence machine is classed with the dynamo as a highly efficient source of electricity. The great advantage of the D'Arsonval galvanometer, called the solenoid galvanometer, is said to be that it does not have to be set up with its coil in the magnetic meridian. Self induction is explained as a particular case of mutual induction. All dynamos are said to give the best results when the resistance in the service conductor is equal to that in the windings of the machine, and we are told that stronger hard-soldered thermopiles are specially suitable for the charging of accumulators. One of the first errors made in the book is in the discussion of an experiment on capacity, which the author mistakes for an experiment on potential—a quantity which has led astray so many writers of elementary books. In this connection we read, as we have read in other books, that a positive body gives up electricity to the earth and that a negative body receives electricity from the earth; but we are not told what the earth itself does when it is either positively charged or negatively charged. No correct definition of the electromotive force of a generator is given, and no satisfactory derivation of Ohm's law for a closed circuit. Under the circumstances we are not surprised to read that Ohm's law does not hold for alternating currents. These matters are so fundamental, and so easy to treat properly, that the remissness of text-book writers is hard to understand. The statements in the appendix with reference to what should be called the electric intensity and the electric tension at the surface of a charged conductor are anything but satisfactory. The

dyne is wrongly defined, velocity is wrongly expressed. In a number of cases equalities and proportionalities are used indiscriminately. In fact, the book is logically weak, as would be expected from the author's statement that "inquiry into the rules of dynamics would carry us too far afield." Much dynamics and much mathematics are wholly unnecessary for the purposes of this work, yet its merits would be greatly increased by the more exact use of the little necessary. The book is provided with a good table of contents and a good index. It is well bound and excellently printed. The misprints noted by the reviewer are exceedingly few.

S. J. BARNETT

Arbeiten aus dem Gebiet der Experimentellen Physiologie. Herausgegeben von Dr. HANS FRIEDENTHAL in Nicolassee bei Berlin. Mit 4 Tafeln und 14 Figuren im Text. Jena, Gustav Fischer. Pp. 493. 1908. Price, 8 Marks.

This collection of papers by Dr. Friedenthal and his collaborators has been prepared in order to bring together a number of contributions scattered throughout various scientific journals, some of which are not easily accessible, and to make them readily available to physiological readers. They have been arranged by the editor, with relation to their content, into the following groups: biological relationships among animals and plants; papers on physiological operative technic, including studies on absorption, the innervation of the heart, and the sympathetic system; studies on physical and physico-chemical topics; papers on the H-ion concentration and the reaction of living substance; and additional contributions of diverse character.

It is impossible here to refer individually to the 55 papers reprinted. Many of them are already quite familiar to biological and physiological workers. This applies, for example, to studies such as those dealing with the fate of foreign sera introduced into the circulation of animals, and with the nature of the forces coming into play during the act of absorption. Friedenthal defends the view that solubility in water is *per se* insufficient to determine the possibility of absorption of substances by cells. We are asked to distinguish between solubility in protoplasm and solubility in water; herein the now well-recognized importance of the cell lipoids for the processes under discussion is duly emphasized. The author has furthermore especially insisted upon the absence of special "vital" forces in absorption.

Friedenthal's earlier observations on the biological relationships of animals and the position of man in the zoological scheme were perhaps not as widely known at the period of their publication as they deserved to be; the so-called "immunity" reactions which were shown in common for man and the anthropoid apes have since been more extensively observed.

Some of the observations on the occurrence and nature of enzymes have more recently lost the significance attributed to them when they were first published. Thus Friedenthal's announcement of the existence of an amylolytic enzyme in the gastric juice of dogs is probably referable to the regurgitation of intestinal contents (including pancreatic secretion) into the stomach—a phenomenon shown by Boldireff to occur with frequency in these animals.

The most significant of all the reprinted papers are, perhaps, those dealing with the reactions of the blood and protoplasm. Friedenthal was among those first to point out the non-existence of an alkaline reaction in the blood in reference to indicators sensitive to carbonic acid; and he showed the importance of the alkali bicarbonate of the serum as a regulatory factor in preventing marked variations from neutrality. These investigations were followed by the publication of a comparatively simple method for the estimation of the reaction of physiological fluids by the use of a series of indicators. The method, which has already found application in the study of physiological problems, is likely to be a help in future research, especially in the study of such questions as acidosis.

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Lectures on the Elementary Psychology of Feeling and Attention. By EDWARD BRADFORD TITCHENER. Pp. x + 404. New York, The Macmillan Co. 1908.

This volume contains eight lectures given while the author was non-resident lecturer in psychology at Columbia University in 1908. As the title implies, they give a résumé and critical discussion of the recent work and current theories of psychology on the two topics mentioned.

The first chapter contains a discussion of sensation and its attributes. The attributes are broadened beyond current usage to seven. They are divided into two groups. The intensive, in which are grouped the familiar intensity, duration and extent together with clearness; the qualitative attributes, that for sight would include hue, tint and chroma. Differences in kind of sensation depend upon distinguishable differences in the qualitative attributes; differences in degree upon differences in the quantitative attributes.

Chapter II. is devoted to a consideration of the criteria that distinguish affection from sensation. It is often asserted that feelings and sensations are different in that we become habituated to feelings not to sensations, that feelings are centrally relatively more intense, that feelings are subjective, sensations objective; the one is non-localizable, the other localizable; that feelings exhibit antagonism in quality and are unclear, while sensation qualities are not necessarily opposed and are or may be clear. The first two of these criteria are rejected absolutely, the next two are held to be doubtful, while the last two alone are retained.

Chapter III. discusses Stumpf's doctrine of feeling as a special kind of sensation, sense feeling. The doctrine is rejected as out of harmony with introspective results and supported by rather uncertain psycho-physical evidence. The fourth chapter is devoted to Wundt's tridimensional classification of the feelings with the same negative result.

The fifth chapter begins the discussion of attention with a discussion of the nature and conditions of clearness. Clearness and attention are identified. The conditions of clearness are found ultimately in the nervous disposition, the predisposition of the central nervous system and sense organs. The sixth and seventh lectures are devoted to the laws of attention. The first asserts that clearness is an independent attribute of sensation; the second that there are always two levels of clearness to be distinguished, although the rigidity of the distinction is softened by the statement that there are minor differences of clearness within each level. The third law is that the peripheral and central adaptation requires time and that as a result (4) there are temporal displacements since these accommodations bring earliest to consciousness the stimulus to which the organism is adapted. The object of attention is always a unitary field within which several part contents may be distinguished. The fluctuations of attention are referred to the periphery. There is finally the hope expressed that it may be possible some day to determine the law of the degree of clearness, but the most that can be done at present is to discuss the various methods that have been suggested for the measurement of attention.

In the final chapter affections would be identified with the unclear elements of consciousness; their sense organs have not yet become fully differentiated. Attention and feeling are positively related. We can attend without feeling, but can not feel without attending. Attention increases the effectiveness of feelings as it does of sensations. Attention is characterized in addition to clearness by its relation to will in the Wundtian sense. Passive and active and secondary passive are retained as real distinctions and supported on genetic grounds. The final theory of attention is in close agreement with Wundt.

These are the outlines of the book, but a summary can give no idea of the painstaking care with which the sources have been gone through, nor of the scrupulous endeavor to give every man and every theory its due. There is a refreshing absence of anything that even approaches dogma, and the greatest

possible readiness to leave a problem open rather than to venture a solution that shall be at all one-sided. In fact, if there is any criticism to be passed it is that anxiety to be absolutely fair to the views of others sometimes prevents the author from stating his own with the positiveness that makes for definiteness. If one wants a statement of recent theories and the established facts in feeling or attention the volume is to be recommended as the best available. It gives not merely a clear, full and sympathetic statement of the theories themselves, but a measured and undogmatic criticism, and the resulting theory of the author.

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Camps and Cruises of an Ornithologist. By FRANK M. CHAPMAN. With 250 photographs from nature by the author. Pp. xvi + 432. New York, D. Appleton & Co. $3.00.

As its title indicates, this book is a series of narratives. But, though popular in style, it is not lacking in seriousness, for it contains many fresh or new observations on the habits of birds which will be of permanent value to ornithologists. It is based largely on the author's field work in gathering material for the now rather well-known "habitat groups" of birds exhibited by the American Museum of Natural History. Therefore, it may appropriately be called a by-product of museum work, and, as such, though published privately, it admirably illustrates the way in which a modern natural history museum may carry its broadening influence beyond its exhibition halls.

The eight sections into which the book is divided contain related chapters, each devoted to a certain species or a single expedition. Some of these have been published previously in periodicals and others will be recognized in certain quarters as having been the subjects of public lectures, but some are entirely new and all are pleasing in style and either replete with real information or most suggestive of possibilities in specialized bird study.

Travels about Home, the first section, includes a few little intimacies with blue jays, meadowlarks and nighthawks and indicates the opportunities for bird study that lie close at hand, even to the busy New Yorker. The next, Bird Life of Two Atlantic Coast Islands (Cobb's Island and Gardiner's Island), deals with some interesting species of water birds likewise found at home but a short distance from our largest cities. Florida Bird Life, following, is notable for its almost exhaustive study of the brown pelican and its revelations of the secrets of the great rookeries of herons and egrets, including the now rare experience of meeting the roseate spoonbill in the breeding season. Bahama Bird Life includes observations on terns, boobies and man o'war birds, but easily takes first rank for its superbly illustrated and fascinating story of experiences in the wonderland of flamingoes. The Story of Three Western Bird Groups briefly relates incidents of visits with the prairie chicken in Nebraska, the golden eagle in Wyoming and various small desert birds in Arizona. This is followed by Bird Studies in California, which is introduced somewhat modestly, perhaps in deference to the splendid work being done by Pacific coast ornithologists; but, in view of the limited time spent in the field, most creditable results are shown, especially in the chapters on the water birds of the San Joaquin Valley and of Lower Klamath Lake. Bird Life in Western Canada, like most of the book, is devoted to water birds, with the exception of a chapter on the white-tailed ptarmigan and other birds of the higher parts of the Selkirk Mountains. The concluding section consists of the single chapter, Impressions of English Bird Life.

The half-tone illustrations, 250 in number, are mostly of that excellent character regularly attained by our best bird photographers. The few that are not technical gems of photographic skill are quite justified by their ornithological interest, while some certainly deserve rank among the most interesting and successful bird photographs ever taken. Typographical errors and a few other slight evidences of haste while the book was in press are rather too frequent to be over-

looked. It is hoped that these will be corrected in later editions.

WILFRED H. OSGOOD

BOTANICAL NOTES

GANONG'S PLANT PHYSIOLOGY

SEVERAL years ago Professor Ganong wrote a very useful little book on plant physiology, which is now expanded into an octavo volume of 265 pages under the title of "A Laboratory Course in Plant Physiology," brought out by Holt in a very handy form for laboratory use ($1.75). The author tells us that the book has a threefold purpose, namely, (1) "to lead students through a good laboratory course in plant physiology"; (2) "to provide a handbook of information upon all phases of plant physiology having any educational interest"; (3) to serve "as a guide to self-education by ambitious teachers or students, who, unable to obtain regular instruction, yet wish to advance themselves in this attractive and important subject."

In pursuance of these objects the author devotes about fifty pages to helpful discussions on the place of plant physiology in botanical education, methods of teaching and study, greenhouse and laboratory plans, apparatus and material. This is followed by the book proper, in which the sequence of subjects is (1) the structure and properties of the protoplasm of plants; (2) the physiological processes of plants, the latter including (*a*) the processes of nutrition (photosynthesis, chemosynthesis, synthesis of proteids, conversion, respiration, absorption, transport, elimination); (*b*) the processes of increase (growth, reproduction); (*c*) the processes of adjustment (irritable response, adaptation). A closing chapter of a dozen or so pages is devoted to methods of manipulation, and to convenient tables and lists.

Looking over the pages of the book, the reader is impressed with the practicability of the suggestions made by the author. They impress one as being based upon much experience, and this is actually the case, for the book is a growth from Professor Ganong's long and successful experience with students in his own classes in plant physiology. The illustrations (68 in number) and full-page plates (4) are especially helpful, and yet not an illustration or plate has been given merely to make the book appear more attractive; every one is needed; every one helps to make some part of the subject more clearly understood. Altogether this is one of the most satisfactory botanical text-books in any department of the science that has come to our notice.

ECONOMIC BOTANY

THE Report of the Chief of the Bureau of Plant Industry of the United States Department of Agriculture for 1908 is an encouraging paper, showing as it does the steady enlargement of the scientific study of plant problems. A full enumeration of all of the work carried forward is impossible here, but the following general outline may give some notion of its extent: Field and laboratory work in pathology and bacteriology; plant life-history investigations; investigations of drug and other special crops, and of poisonous plants; crop technology, cotton standardization and fiber investigations; grain standardization; seed laboratory; physical laboratory; investigations and experiments in the semi-arid west and southwest; demonstrations and experiments with field crops; Arlington experimental farm and truck-crop investigations; investigations in pomology; greenhouses, gardens and grounds; farm management investigations; farmers' cooperative demonstration work; work connected with the purchase and distribution of seeds; special testing gardens in the field. Under each of these heads are details of many experiments and studies of great botanical interest, and of still greater interest to farmers, gardeners and other growers of plants. Indeed, one can scarcely open a page of this pamphlet of 135 pages without finding an interesting and suggestive paragraph. The people of the country have reason to be proud of this bureau of our National Department of Agriculture.

Another paper which appeals to the economic botanist is one from the New York Agricultural Experiment Station, entitled

"Troubles of Alfalfa in New York" (Bull. 305), in which are taken up such things as: uncongenial soil conditions; winter injury; dodder; weeds; fungus diseases; root-knot; diseases of unknown cause, etc. The whole paper is full of interesting facts for the grower of alfalfa, and most of it should interest the general botanist. The portion dealing with dodder (*Cuscuta*) is especially interesting. A valuable bibliography including 115 titles closes the bulletin.

In a recent number of the Kew Bulletin of Miscellaneous Information Mr. Fred Turner's paper on "The Economic Value of the Australian Pasture Herbs" is interesting to American botanists as showing the great differences between the two countries. His list includes a *Trigonella, Erodium, Geranium, Boerhaavia, Blennodia lepidium, Marsilia, Daucus, Psoralea, Swainsona, Plantago, Calandrinia, Portulaca* and *Tetragonia*. Of the *Marsilia* (*M. drummondii*) he says:

> This dwarf, clover-like plant, occurs in the interior of all the Australian states, generally on the margins of swamps or where water collects in shallow pools after rain. When the water subsides the young plants grow rapidly in the mud, and eventually cover the ground with dense vegetation, reminding one of cultivated clover. All kinds of stock are extremely fond of this plant, which is regarded as nutritious food.

PAPERS ON FUNGI

AN important paper on the "Geoglossaceae of North America," by Mr. E. J. Durand, appeared recently in "Annales Mycologici" as one of the contributions from the department of botany of Cornell University. These plants are discomycetous fungi of somewhat doubtful affinities, Shroeter associating them with *Rhizinaceae* on the one hand, and *Helvellaceae* on the other in the order *Helvellales*, while Boudier places them near *Helotiaceae* and *Mollisiaceae* in *Pezizales*. With the latter view Mr. Durand agrees. In his paper, after an interesting introduction of nine or ten pages, the author makes a synopsis of the eleven genera considered, and then follows with full generic and specific descriptions, with exact citations of all the material examined in every instance. This portion of the paper, with index and explanations of the plates, fills eighty pages, and these are followed by eighteen plates, nearly one half being made from photographs. Forty-two species are recognized, and of these nine are here described for the first time. The paper should do much to stimulate the search for the plants of this group of fungi.

A recent number of the *Bulletin* of the College of Agriculture, of the Tokyo Imperial University of Japan, contains two important papers on fungi by the Japanese botanist, S. Kusano. One of these is entitled the "Biology of Chrysanthemum Rust," and discusses "black rust" (*Puccinia chrysanthemi*), "white rust" (*P. horiana*) and "brown rust" (*Uredo autumnalis*). The exact relationship of the latter has not yet been determined. The opinion is expressed that the rusts occurring on cultivated species of *Chrysanthemum* in Japan originated upon the wild *Chrysanthemum* of that country (*C. decaisneanum*).

The second paper by Kusano, under the title of "Notes on Japanese Fungi," is in continuation of a series of articles on this subject, the present one being devoted to species of *Puccinia* known to occur on the leaves of bamboo plants. Five species are enumerated, viz.: *P. phyllostachydis* (on *Phyllostachys bambusioides*); *P. longicornis* (on *Sasa paniculata* and *Arundinaria japonica*); *P. kusanoi* and its variety *azuma* (on *Arundinaria simoni, A. variabilis, A. naharia* and *Sasa* spp.); *P. sasae* (on *Sasa borealis*). From observations on these rusts the author concludes that "it is highly probable that the uredosori originate from the sporidia," that is, without the intervention of the aecidial stage.

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SPECIAL ARTICLES

THE OTTER IN EASTERN MASSACHUSETTS

IN a recent number of SCIENCE[1] Mr. C. E. Gordon reports that otters have been repeat-

[1] Vol. XXVIII., No. 726, November 27, 1908, pp. 772–775.

edly taken or seen within the past three years along the Connecticut River valley in central Massachusetts. He thinks they have been increasing there of late and his evidence, when compared with that of earlier writers, seems to show that they are at least as numerously represented now as they were fifty or sixty years ago. In his opinion it is "possible to postulate the persistence of these animals in this state as a logical consequence of their shy habits and tendencies to roam about" although their "abundance" "in the Connecticut River valley has suggested" to his mind "that they have come along this waterway from the north outside the limits of the state to the smaller tributaries of the river in the lowland of the valley," whence "they may have traveled eastward through the valleys of the Ware, the Assabet, and the Blackstone to the seaboard." There is, too, he believes, a "possibility of their having come along another waterway from the north—the Merrimac, along the tributaries of which—the Concord and the Nashua—they might have easily made their way southward." He says further, the "comparative scarcity" of the otter "in the eastern part of the state is noteworthy." Of its recent occurrence there he is able, apparently, to give but one instance—on the authority of Dr. Glover M. Allen, who "found unmistakable tracks of the otter near Dedham, Norfolk County, two winters ago."

That otters may occasionally reach central Massachusetts from northern New England by way of the Connecticut River is not improbable, for they are restless, wide-roving creatures, accustomed to making long journeys through convenient waterways and also to traveling overland from pond to pond and stream to stream, sometimes over high mountain ridges. I suspect, however, that at the present time they are more likely to move up than down the Connecticut, for Mr. Gordon's testimony indicates that they are now more plentifully represented along the Massachusetts reaches of that river than in the wilder regions near its source—of which I know something from personal experience.

I have been familiar with Concord River and with the lower reaches of the Assabet, for upwards of forty years. If, during this period, otters have frequented, or even casually visited either of these streams, the fact remains unknown to me. But they have been found to my knowledge along the Sudbury River, not far above where it unites with the Assabet to form the Concord, and most frequently, I believe, in or near what is known as Fairhaven Bay, a shallow expansion of the Sudbury, lying partly in Concord and partly in Lincoln. Here my friends, Mr. Charles M. Carter and Mr. George C. Deane, had a good view of one, in broad daylight, early in the month of June, 1876. It swam across the bay from shore to shore, moving through the water swiftly and carrying its head well above the surface after the manner of its kind. During the next ten or twelve years I heard repeatedly of otters that had been seen or tracked by local hunters and fishermen of my acquaintance, either along the river or its small tributary streams, and invariably within a mile or two of the bay. One man in whom I had full confidence reported finding fresh otter "slides" in the deep, boggy hollow which the Fitchburg Railroad crosses just to the eastward of Walden Pond and which forms the source of a cold trout brook that flows into Fairhaven Bay. Another account, for the truth of which I can not vouch but which, as I remember, was very generally credited at the time, related to an otter said to have been killed in midwinter in the public road near the bridge that spans the river just above the bay, by a farmer who lived at Nine Acre Corner, an outlying settlement of Concord. As the story ran, this man was wending his way homeward through deep snow, late one stormy night, when he was startled by the sudden appearance of the otter directly in front of him and only a few yards away. On seeing him it left the road and plunged into a snow drift, which so impeded its further progress that he overtook it without much difficulty and despatched it with a stick.

A man living in Lincoln, about a mile and

a half to the eastward of Fairhaven Bay, assured me, in the summer of 1889, that otters were then frequenting a meadow near his house. He thought there were at least two or three of them and he feared they were preying on some trout that he had put in a series of connecting ditches filled with clear, cold water. I heard the following year that despite his repeated attempts to shoot and trap them, they finally departed unharmed, after haunting the meadow for several months and eating the last of his trout. As far as I am aware there is no later instance known of the occurrence of the otter in the region about Fairhaven Bay, but if it be still found in Charles River it is likely to reappear at any time in the Sudbury, for these streams approach one another closely in several places.

For the Charles I have a manuscript record pertaining to a time less recent than that when Dr. Allen's observation was made, yet not so very long ago. It is on the authority of Mr. Shelley W. Denton, who, in February, 1894, obtained definite evidence that an otter had been killed, about the fifth of that month, in South Natick. It appeared early one cold morning on the ice at an air hole and fell a victim to a well-aimed shot fired by a man named Frank Carroll from the window of a stable that stood on the edge of the river not far from the village.

In the towns of Readville and Canton, only ten or a dozen miles to the southward of Boston, otters were not uncommon less than twenty years ago. They were seen occasionally in the Neponset River and my friend Mr. Roland Hayward often found their tracks on the banks of certain of its tributary brooks which he was accustomed to fish for trout. Most of his fellow fishermen, the otters, seem to have eluded the local hunters and trappers, but one was shot in Ponkopog Pond on March 30, 1893, by the Messrs. Charles W. and J. H, Bowles. It came swimming in from the middle of the pond directly towards the brush stand on the shore, where they were lying in wait for ducks. On reaching their little flock of *wooden* decoys it seized one of these in its teeth, when Mr. J. H. Bowles fired, killing it almost instantly. He or his brother skinned and mounted it. The specimen now forms one of the most attractive wall ornaments of my private museum, for they were kind enough to give it to me when, a few years later, they went to the Pacific coast. It is an exceptionally large and handsome animal, in dark, richly colored pelage. Mr. F. B. McKechnie, who now lives in the house at Ponkopog formerly occupied by the Bowles family, tells me that he has seen no otter signs of late in the Neponsett River valley although he has heard that two otters were trapped in the autumn of 1907 in the Neponsett meadows, by Mr. Rogers. He further informs me that Mr. Arthur Smith saw the track of an otter near Blue Hill about three years ago.

If, as seems not improbable, the recent presence of otters in some numbers in the lower portions of the Neponsett River valley has been due—at least in part—to immigration from regions somewhat more remote, the influx is likely to have come, not from the north, but from the south. For it is neither known to me nor probable that these animals have occurred plentifully of late anywhere immediately to the northward, whereas at no great distance to the southward, throughout most of the wooded parts of Cape Cod, they are—or have been recently—much more numerously represented than I have ever found them to be elsewhere in New England, even about the lakes and rivers of northern Maine and New Hampshire. Nor is this surprising, in view of the fact that very much of the Cape remains unsettled and, indeed, essentially a primitive wilderness, which, although somewhat over supplied with keen and successful hunters of deer, foxes, game birds and waterfowl, has almost wholly lacked expert native trappers because of the general scarcity or absence, for half a century or more, of furbearing animals of any considerable value. It has, too, among other attractions, innumerable ponds and streams, such as the otter loves to frequent; for most of these are filled to the brim at every season with clear sparkling water and bordered by dense woods and thickets, or fringed by reeds or by cat-tail flags, while nearly all abound with fish of

one or another kind. They are, moreover, not only numerous and wide-spread, but also frequently joined to one another by rivulets or by springy runs and bushy swamps; so that they form, in effect, extended and intricate systems of more or less perfectly connected waterways, through which semi-aquatic creatures like the otter can roam at will over wide areas without often having to cross dry land. Such conditions suit the otter perfectly. Favored by them and also, for a time, by almost complete immunity from molestation, he throve and multiplied on the cape until he had repopulated most of his ancestral haunts. That the period during which he reoccupied these in any number does not date far back nor quite down to the present time, I will now attempt to show.

My first visits to Cape Cod were made in 1866 and 1867. Between 1871 and 1878 I went there almost every year, sometimes in spring or summer to collect the smaller birds of the region or their eggs, often in late autumn for the quail and duck shooting. During these trips I became familiar with many of the ponds and streams in Plymouth and Barnstable counties. If they harbored otters in any numbers at that time I failed to learn of the fact, either through personal observation or from local hunters whom I employed as assistants or guides. All these men agreed, if I am not mistaken in my recollection, that the otter was then, and had been for many years previously, so very rare throughout the cape region that even its tracks were seldom seen. About 1890 (it may have been a year or two earlier or later) I began to hear rather frequently of otters that had been seen or tracked on Cape Cod. In the course of the next decade they increased in numbers and extended their distribution until they had become of common occurrence almost everywhere from Wareham and Plymouth to Brewster and South Yarmouth. No doubt they ranged still farther eastward along the cape, if not also northward to Canton and Readville, as I have already suggested. They seem to have reached their maximum abundance about the beginning of the present century. Up to this time they were not much molested, for they are exceedingly wary creatures and few of the local hunters knew how to capture them: but within the past five or six years, as I am informed by Mr. Outram Bangs, the Marshpee Indians have trapped them systematically, not only in the Indian Reservation near Cotuit, but elsewhere over the cape, and with such skill and success that they have been everywhere very considerably reduced in numbers. When they were still plentiful I saw their signs in many places about the sandy or muddy margins of ponds, brooks and swamps in Plymouth and Barnstable counties, usually in places remote from civilization, but sometimes—as at South Yarmouth—within a mile of village centers and even nearer outlying farmhouses, while I have occasionally tracked them from pond to pond over high ridges traversed by public roads. Mr. Bangs has had still more frequent and interesting experiences of a similar kind, for his summer home at Wareham lies within easy reach of many an otter-haunted pond and stream. When I was visiting him there in 1900 he took me one day (June 13) to a wide, swift-flowing brook into which an otter, disturbed by our approach, had evidently plunged only a few moments before. The eddying water was still roily where he had entered it and on the shore we found his footprints and a dead alewife that he had been eating. It was perfectly fresh and, indeed, still bleeding at the point where its head had been bitten off. No doubt this was the same otter that Mr. Bangs had seen near the same place only a week or two before and it may have been also the one that he shot there some three years later (on March 31, 1903), whose mounted skin is now on exhibition in the Museum of Comparative Zoology.

The evidence above presented is undeniably too fragmentary and inconclusive to positively discredit Mr. Gordon's suggestion that eastern Massachusetts may have been restocked, within recent times, by otters that have come directly from Maine and New Hampshire or indirectly thence by way of the Connecticut River and such eastward-flowing streams as the Assabet. Indeed, I am by no means dis-

posed to deny that this may have happened. But I consider it much more probable—as does Mr. Gordon apparently—that most, if not all, of our otters (at least those found in eastern Massachusetts) are descended from primitive native stock. For it is evident that the species has never been completely extirpated in Massachusetts, even in the neighborhood of such large cities as Boston and Springfield, while any assumption that there have been immigrations from farther north is unsupported by known evidence and also unsatisfactory because of the fact (to which I could bear strong testimony if it were necessary) that in most parts of northern New England otters are, and have been for twenty years or more, far from common. Hence it is difficult to believe that many of them have come to us from that direction, although a very few may stray southward, at infrequent intervals, along the Connecticut and Merrimac rivers. However this may be, I am decidedly of the opinion that if, within recent times, there has been anything in the nature of an overflow of otters from localities which they have somewhat over-populated, its source is most likely to have been Cape Cod. For there, as I have said, the otter has been more numerously represented, over wide areas, during the past quarter of a century, than anywhere else in New England.

WILLIAM BREWSTER

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SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 212th meeting of the society, held on Wednesday, January 13, Mr. G. K. Gilbert presented the following paper: "Earthquake Forecasts," a paper read before the Association of American Geographers at Baltimore, on Friday, January 1. This paper was published in SCIENCE and hence no abstract is furnished herewith.

AT the 213th meeting of the society, held on Wednesday, January 27, the following papers were presented:

Regular Program

Some Observations on Rocky Mountain Faults: CHESTER W. WASHBURNE.

The faults observed may be referred to three genetic types.

Type I. Normal dip faults crossing the axes of anticlines.—The examples considered displace strata just above the Colorado shale, and do not penetrate the latter over 300 feet. None reach the Carboniferous. The maximum vertical displacement, 50 to 300 feet, is on the anticlinal axes and decreases down the limbs until the faults become small monoclinal flexures and finally disappear. The motion along each fault plane had two essential components: (1) vertical, either (*a*) upward movement of the foot-wall, or (*b*) downward movement of the hanging wall; and (2) horizontal, either (*a*) inward movement of the foot-wall toward the anticlinal axis, or (*b*) outward movement of the hanging wall away from the axis. Field observations show that these movements have been combined in one of two ways. A: (1 *a*) with (2 *a*); or B: (1 *b*) with (2 *b*). Combination A would be produced during folding by compression resulting in axial thickening of the underlying shale and upward creep on the limbs, the movement being greater on the up-thrown or foot-wall side of each fault. Combination B would be produced by creep down the limbs of anticlines and axial thinning of the Colorado shale, the movement being greater on the down-thrown side. This might be caused during the folding, by the tension of stretching over the underlying Paleozoic limestones, or subsequently by gravitative creep down the limbs, under the pressure of about 3,000 feet of overlying rock. Combination A is the most probable. The breaks were probably initiated as lines of scission or *blätter* between blocks that were shoved unequally.

Type II. may, for convenience, be called *faults of vertical thrust*, because the vertical component is large. The type is characteristic of the margins of broad, domical, flat-topped uplifts such as the Marysville batholith and the Bighorn Mountains. The faults are usually intimately associated with flexures. The faults that are of the same kind, orographically, as the flexures, *i. e.*, the faults that add to the height of the uplift and to the depth of the adjacent depression, are named *additive*. These are due to the same forces that elevated the mountain mass. The additive group includes both "thrust" and "normal" faults of the current nomenclature. The complementary group of faults subtracts from the height of the uplift and is therefore designated *subtractive*. They are due to forces opposite in kind to those that made the uplift, probably to gravitative subsidence. All subtractive faults are "normal."

Type III. Tilted fault blocks.—Many great series of step faults are hard to explain by the idea of collapse of an uplift. In some cases the inclination of the strata require that the uplift have a height far exceeding any known elevation on the earth, yet there is no physiographic evidence that such elevations existed. It is more probable that the tilting and faulting of the blocks were concomitant. The hypothesis of continental creep can not explain some of the phenomena.

A suggestion is furnished by a faulted pebble in schist, collected by J. S. Diller. (See U. S. Geological Survey Bulletin 353, fig. 4, p. 22, and *American Journal of Science*, Vol. XXIV., fig. 5, p. 12, July, 1907.) According to Becker the schistose structure is in the final direction of maximum slide, and the oblique faults are in another final direction of maximum slide subordinate to the first. Both were initiated by the same rotational shear or scission, which tilted the oblique faults forward, and which produced practically no change in the direction of the schistose structure.

A cross-section of the mountains of Colorado bears a strong resemblance to this pebble. The schistose structure or direction of greater motion corresponds with the thrust faults and hypothetical buried sheer zones of the mountains. The cross-breaks correspond with the step faults of South Park and the Leadville District. The initial formation of the breaks on the principles of cleavage laid down by Becker, and the subsequent forward rotation of the fault blocks by the same shearing thrust, would explain all the phenomena. In this way both the thrust faults and the normal step faults could be produced at the same time by the same forces.

Quartz as a Geologic Thermometer: FRED. EUGENE WRIGHT and ESPER S. LARSEN.

On any temperature scale certain temperatures, as the boiling and freezing points of water, are arbitrarily chosen as fixed and standard points of reference. For the geologic temperature scale, similar points must be selected and for this purpose melting points of minerals and mineral aggregates (eutectics), and especially inversion temperatures of enantiotropic forms of the same compound, may serve. Quartz is well adapted to furnish one and possibly two such points, since it has two inversion temperatures, the one at about 560°, where α-quartz inverts to β-quartz, and the second at about 800°, where β-quartz changes under certain conditions to tridymite. Mügge[1] has recently shown that at 560° quartz changes to a second form called β-quartz, which is also hexagonal and trapezohedral in its symmetry but in all probability hemihedral instead of tetartohedral. This change in symmetry class involves certain changes, as crystal habit, character of twinning and intergrowth of right- and left-handed quartz, and fracturing of crystals, which in turn can be used directly to distinguish quartz formed above 560° from that which has never reached that inversion temperature. These criteria were applied to quartz from 43 different localities, 17 of vein quartz, 13 of pegmatite and 13 of granite and granite porphyry quartz. Nearly 500 plates of quartz in all after the basal pinacoid were cut, polished, etched and tested from these view-points—the net result of the investigation being that the vein quartzes were formed below 560°: also the quartz of certain pegmatites, while all granite, granite porphyry and graphic pegmatite quartzes were probably formed above 560°. By thus fixing temperature limits of formation of quartz, it is possible in many instances to determine limits for other minerals associated with quartz.

The Stream Robbery on which the Belle Fourche Reclamation Project is Based: N. H. DARTON, U. S. Geological Survey.

The Belle Fourche project provides for the irrigation of 85,000 acres of the Great Plains lying north of the Black Hills in western South Dakota. The water is to be taken from Belle Fourche River just below the town of Belle Fourche, carried down the north bank a short distance, and then by a deep cut through a narrow divide to a large reservoir sustained by a long dirt dam. From the reservoir it will be carried by ditches into a large, low-lying basin, where it will be utilized. As in most reclamation projects, the topography presents certain favorable peculiarities. In this case it is that the river near Belle Fourche is considerably higher than the wide basin of tributaries on the opposite side of a narrow divide. This basin was excavated in soft shale by creeks of moderate size. Originally the present river was a very small branch creek, but having greater declivity, it finally cut back through a narrow divide and tapped the headwaters of the Little Missouri River. The river has not yet greatly deepened its valley near Belle Fourche, so that now the water can easily be carried by a short canal system into the large, low lying basin to the north.

[1] "Neues Jahrbuch," Fest band, 181–196, 1907.

The locality at which the Little Missouri was tapped, is in the big bend thirty miles northwest of Bele Fourche. Its features are well shown on the Aladdin quadrangle of the U. S. Geological Survey. The former channel is now a flat-bottomed gap through the divide about two miles long and known as Stoneville Flat. To the north it coalesces with the present Little Missouri Valley, while to the south it ends in a cliff of shale eighty feet high descending to the present Belle Fourche River.

AT the 214th meeting of the society, held on Wednesday, February 10, under informal communications, Dr. J. W. Spencer presented briefly some "Notes on Borings in the Vicinity of Whirlpool Rapids."

Regular Program

The Pleistocene Phenomena of Southeastern Wisconsin: WM. C. ALDEN.

This paper is based upon detailed surveys of an area of about 8,600 square miles south of latitude 44° N., made under the direction of Dr. T. C. Chamberlin. Outside the terminal moraines of the Wisconsin ice sheet is a deposit of drift regarded as of Illinoian age. The composition of the drift and trend of striæ show that the direction of ice movement was, in general, westerly to the limit of the drift. The average estimated thickness over 470 square miles of this area is 45 feet. Very compact reddish till and contorted laminated clays exposed at intervals on the shore of Lake Michigan at the base of the bluff are correlated with this stage of glaciation.

Some, at least, of the vegetal deposits penetrated by wells at many places throughout the area of Wisconsin drift probably represent the Peorian interval of glaciation. To this horizon also may belong the logs and stumps observed by Dr. J. W. Goldthwait near Manitowoc and Two Rivers, Wis. One stump was found still rooted in dense reddish clay provisionally classed with the Illinoian deposits.

The Green Bay, Lake Michigan and Delavan lobes of the Late Wisconsin ice sheet are shown to have been contemporaneous in their maximum extension. Estimated average thickness of drift in the terminal moraine of the Green Bay Glacier at the south end of the lobe is 119 feet (this includes older drift). Along the west side, where no earlier drift is known, the thickness is 61 to 77 feet. The estimated average thickness over 1,611 square miles of the ground moraine, including recessional moraines, is 71.4 feet. Seventeen hundred and fifty drumlins of good form occur in the area examined. Evidence is found that some were formed when the ice reached only to one of the inner moraines. Eskers were formed at or near the base of the ice and the esker-forming streams were controlled by the configuration of the drift surface. Direction of movement in the adjacent parts of the two glaciers was almost opposite. The interlobate moraine is 100 to 300 feet high, the relief generally being entirely of drift. Drift of the Lake Michigan glacier estimated as 100 to 150 feet thick at the south, 160 feet at the north and 45 feet midway between. Recessional moraines are well marked.

A readvance of the Lake Michigan glacier covered the moraines east of the Milwaukee River with a deposit of red till southward to Milwaukee. Between Sheboygan and Plymouth this extended 14 miles west of the lake shore. The estimated average thickness of this deposit is 34 feet. In Sheboygan and Manitowoc counties there is a well-marked terminal moraine of red till overlapping the earlier recessional and interlobate moraines. A similar deposit of red till bordering Lake Winnebago indicates a readvance of the Green Bay glacier to the south line of Fond du Lac Township. This readvance is believed to have occurred at the Glenwood stage of Lake Chicago. There is a faint development of the Glenwood beach on the red clay formed when the ice again retreated. This is traceable north through Sheboygan County. In southern Sheboygan County slight traces of a beach occur at the Calumet level. Traces of the Toleston beach occur in Kenosha County, but this was mostly obliterated during the formation of the Nipissing shore, which is strongly marked by cliffs and terraces about 14 feet above Lake Michigan. The Algonquin beach is not distinguishable, possibly it is identical with the Toleston shore. As shown by Goldthwait, there has been little or no deformation of the old shore lines in this area. Filling in the lower part of Milwaukee River valley, consisting of marsh deposits and alluvium extending 50 feet below the level of the lake, indicate that at some time following the Glenwood stage and deposition of the red till the lake waters stood considerably below their present elevation.

Clinton Iron Ores in the Birmingham District, Alabama: ERNEST F. BURCHARD.

The Clinton formation lies on the flanks of a non-symmetrical anticlinal valley, extending northeast and southwest for about fifty miles, with the city of Birmingham near the middle. Only on

the east limb of the anticline in Red Mountain near Birmingham is the ore of commercial value at present. Northwest of this valley lies the Warrior Field, containing coking coals, while to the southeast lies the Cahaba Field, containing high-grade steam and domestic coal. Cambro-Ordovician dolomite within the valley and Mississippian limestone between the ore outcrop and the coal fields both afford stone for fluxing. The topography is of the ridge and valley type, very favorable for transportation lines to reach the outcrops of ore, stone and coal. The ore is of sedimentary origin. It contains approximately 36 per cent. of iron, 12 to 25 per cent. silica, 8 to 20 per cent. lime and .33 per cent. phosphorus. It occurs in beds like coal, but, unlike coal, the beds are subject to residual enrichment on the outcrop, due to solution of soluble constituents; also they are not so broadly extensive as coal beds. Studies of the strike sections of the ore on the outcrop and of sections at right angles to the outcrop by means of mine openings and drill records show that the beds are long, narrow, lens-like bodies. The quality of the unweathered ore is fairly constant in the direction of the dip. All the facts obtained during recent geological surveys of this field indicate that the ore is the result of original deposition of ferruginous sediments and that, so far as the material continues of workable thickness, it will mostly be found of workable quality.

The Earthquake Rift in Eastern San Luis Obispo County, California: Ralph Arnold and H. R. Johnson.

This paper embraced a description of some of the topographic features along the earthquake rift and was illustrated by lantern views showing the terraced aspect of the country adjacent to and the offsetting of streams by the rift. An instance of offsetting was described in detail where a stream flowing southwestward from the Temblor Range strikes the rift at right angles, is directed to a northwesterly course along the rift for 400 feet, and finally leaves the rift at right angles and flows off on the plain. The scarp along the rift at this point is on the northeast side, and there is apparently a small alluvial fan developed where the stream leaves the rift on the southwest, so that any hypothesis other than one in which a horizontal movement of 400 feet is assumed does not seem to explain the conditions found here.

Philip S. Smith,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 659th meeting was held on January 30, 1909, Vice-president Wead presiding.

The following papers were read:

A Proposed Method for Determining the Solar Parallax: Dr. C. G. Abbot.

The author cited the recently published values of the solar parallax obtained by observations of the minor planets, and especially of Eros. These generally agree very closely and yield a value 8".80 or a trifle higher. The recent long-continued and careful work of Doolittle, on the other hand, has given the value of the aberration constant as probably 20".51, corresponding with a parallax 8".783. Küstner and Halm have employed the Döppler principle to determine the velocity of the earth in its orbit, by observing the displacements of lines in the spectra of certain stars at intervals of six months. Küstner obtained thereby 8".84 for the solar parallax.

The author proposed to use two cœlostats and reflect simultaneously on a powerful spectroscope the light of Venus and Mars. A differential velocity of these objects as great as 28 km. per second is available. Adams has in similar fashion determined the velocity of rotation of the sun with a probable error for a single photographic plate of 0.004 km. per second. An experimental photograph of Venus's spectrum has been made with the tower apparatus at Mt. Wilson, on the same scale employed by Adams for the sun, in two hours' exposure. It is thought that a scale of spectrum one fifth as great can be used in practise for a simultaneous exposure on Mars and Venus. By alternating the two cœlostats on successive nights, and by carefully reducing the light of Venus to equal that of Mars, and by using a long focus telescope to form the images, so that only the central part of the disks of the planets would be used, the author hoped the method would be capable of yielding in ten nights a value of the parallax accurate to one part in 2,000.

The Magnetic Properties of Iron: Their Application and Measurement: Mr. C. W. Burrows.

The 660th meeting was held on February 13, 1909, Vice-president Wead presiding. The following papers were read:

A New Method for Determination of Focal Length: Mr. I. J. Priest.

This method, based on the Fabry and Perot interferometer, gives the focal length directly and accurately; it is adapted to lenses of all focal lengths; it can be used for the determination of achromatism; and finally it is unique in that

linear measurement only is involved—a length taken with a micrometer. The use of a costly and cumbersome optical bench is not required. Briefly, the method is rapid, precise and convenient. The speaker gave a general account of the theory of fringe formation in the Fabry and Perot interferometer. The several sources of error were considered and all shown to be of the order of one part in one thousand, and hence the error in the determination of focal length f not greater than $f/1,000$.

The Coefficient of Reflection of Electric Waves at a Transition Point: Dr. LOUIS COHEN.

The paper discussed mathematically an important practical question, applicable to many present-day engineering problems, especially to the transmission of power by means of high potential electric currents. It was pointed out that in passing from an air circuit to an underground cable the potential might easily be almost doubled at the point of transition, due mainly to the difference in the capacities of the two parts of the circuit. In the cases of circuits having large localized inductances the potential may at places become nearly double the ordinary line potential. The discussion was in reference to alternating currents.

R. L. FARIS,
Secretary

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

THE thirty-second meeting of the society was held at the New York University and Bellevue Hospital Medical College, February 17, 1909, with President Lee in the chair.

Members present: Alsberg, Atkinson, Auer, Banzhaf, Beebe, Berg, Burton-Opitz, Ewing, Famulener, Foster, Gay, Gies, Henderson, Jacobs, Joseph, Kast, Lee, Levene, Levin, Lewis, Lusk, Mandel, Meltzer, Meyer, Murlin, Noguchi, Opie, Pearce, Storey, Terry, Wallace, Weil.

Members elected: John F. Anderson, T. G. Brodie, L. J. Cole, Martin H. Fischer, Richard V. Lamar, Max Morse, Hans Zinsser.

Officers elected: President, Frederic S. Lee; *Vice-president*, William J. Gies; *Secretary*, Eugene L. Opie; *Treasurer*, Graham Lusk.

Resolution adopted: Resolved, That, on the retirement of Professor William J. Gies from the secretaryship of this society, after a service of six years, the society expresses to him its appreciation of, and its cordial thanks for, his most efficient labors. To Professor Gies's devoted work is due, in great part, the honorable position which the society has already attained among the scientific societies of this country.

Scientific Program[1]

Yandell Henderson: A method for the direct observation of normal peristalsis in the stomach and intestines.

A. I. Ringer (by invitation): Studies on the effects of carbon monoxid poisoning.

George B. Wallace and Hugo Salomon: Intestinal excretion during diarrhea.

R. Burton-Opitz and Daniel R. Lucas: The vascularity of the kidney as influenced by sensory impulses.

Paul A. Lewis: The influence of temperature on hemolysis in hypotonic solutions.

Frederick P. Gay: A carcinoma of the rat (Flexner-Jobling) considered from the standpoint of immunity.

A. O. Shaklee: Influence of temperature upon pepsin.

Nellis B. Foster and James C. Greenway: Synthesis of uric acid.

Hideyo Noguchi: Some critical considerations on the serum diagnosis of syphilis.

D. Manson, L. Kristeller and P. A. Levene: On nitrogenous metabolism in chronic nephritis.

Carl L. Alsberg: The formation of gluconic acid by the olive-tubercle organism and the function of oxidation in some microorganisms.

Jacques Loeb: On the fertilizing and cytolytic effect of soap.

T. Brailsford Robertson and Theodore C. Burnett: On the depression of the freezing point of water due to dissolved caseinates.

W. J. MacNeal, Lenore L. Latzer and Josephine E. Kerr: The daily excretion of bacteria in the feces of healthy men.

Walter A. Jacobs and P. A. Levene: Further studies on the constitution of inosinic acid.

John F. Anderson and M. J. Rosenau: The effect of heat on the anaphylactic properties of proteins.

Charles A. Elsberg: A skin reaction in carcinoma from the subcutaneous injection of human red blood cells.

EUGENE L. OPIE,
Secretary

[1] Authors' abstracts of the papers read before the Society for Experimental Biology and Medicine are published in the *Proceedings of the Society for Experimental Biology and Medicine*. A number is issued shortly after each meeting, and costs twenty cents a copy. Copies may be obtained from the managing editor, Eugene L. Opie, Rockefeller Institute for Medical Research, 66th Street and Avenue A, New York.

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

The sixth regular meeting of the session of 1908–9 was held at the Chemists' Club, March 5.

The following papers were presented:

New Aromatic Amino Acids: A. H. Kropff.

The paper described the method of formation of a certain new diamino isophthalic acid and a diamino toluic acid and of various derivatives of these acids; also some new derivatives of a nitroamino isophthalic acid and a diamino benzoic acid.

Some New Quinazolines: R. A. Gortner.

A brief statement was given of further work in the quinazoline field, including some new anthranils and the preparation of some amino and carboxylated quinazolines.

The Determination of Niobium in the Presence of Tantalum.

The process given consists in the reduction of niobium by means of zinc and acid and the subsequent titration with permanganate.

On Tetrachlorether and Dichlorvinylether: William Foster.

The paper dealt with an improved method for the preparation of tetrachlorether and a new method for the preparation of dichlorvinylether together with the physical properties of these compounds; also with the preparation of ethoxychloracetylchloride by the action of oxygen on dichlorvinylether with a study of the mechanism of the oxidation.

The Industrial Manufacture of Anhydrous Chlorine and the Phenomena Connected with Chlorine Detinning: Elmer A. Sperry.

The chlorine process of detinning tin plate scrap was described and illustrated by lantern slides and samples. The more important conditions which have made the process commercially successful were set forth. These included the preparation of liquid anhydrous chlorine, the use of a special form of apparatus for regulating the temperature of the reaction, and an electrolytic method for rendering detinned steel free from iron oxide and tin alloy. The tin tetrachloride resulting from the process was shown and its properties, which required special methods of handling, were considered.

The following officers were elected for the session of 1909–10:

Chairman—Morris Loeb.

Vice-chairman—Charles Baskerville.

Secretary-Treasurer—C. M. Joyce.

Executive Committee—W. D. Horne, A. G. Stillwell, C. B. Zabriskie and David Wesson.

C. M. Joyce,
Secretary

THE AMERICAN MATHEMATICAL SOCIETY

The one hundred and forty-second regular meeting of the society was held at Columbia University on Saturday, February 27, 1909. The brief program required only a single session. Twenty-four members were in attendance. President Maxime Bôcher occupied the chair. The council announced the election of the following persons to membership in the society: Mr. W. T. Campbell, Boston Latin School; Professor W. A. Garrison, Union College; Mr. D. D. Leib, Johns Hopkins University; Professor William Marshall, Purdue University; Mr. J. B. Smith, Richmond, Va., High School; Mr. C. M. Sparrow, Johns Hopkins University. Ten applications for membership were received.

Professor Bôcher tendered his resignation as member of the editorial committee of the *Transactions*, to take effect August 15, it being his intention to spend the coming academic year abroad. Professor Osgood was appointed to fill the unexpired term.

The following papers were read at this meeting:

Edward Kasner: "Brachistochrones and tautochrones."

D. C. Gillespie: "On extremal curves which are invariant under a continuous group."

Virgil Snyder: "Infinite discontinuous groups of birational transformations which leave certain surfaces invariant."

Professor Bôcher presented certain results in extension of his paper "On systems of linear differential equations of the first order," read February 22, 1902, and to be published in an early number of the *Transactions.*

The San Francisco section of the society also met on February 27, at Stanford University. The Chicago Section meets at the University of Chicago, April 9–10. The next meeting of the society will be held at Columbia University on April 24.

F. N. Cole,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 9, 1909

CONTENTS

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE AND INVESTMENT[1]

INTRODUCTION

THE influence of science upon the investment of capital and the employment of labor in productive enterprises is far from receiving its due recognition in systematic economics. There is a vague sort of knowledge that science and productive industry are related much as a handmaid is related to a household. One looks in vain, however, in any of the standard treatises on economics for anything like an adequate appreciation of the place of the natural sciences in that all-engrossing and highly standardized process of production and exchange which makes up the modern system of industry known as capitalism.

One reason for this lies in the fact that the line of approach of the professional economist to the existing system has been by way of politics or philosophy—by inexact and speculative methods, rather than by the more exact methods of experiment and verification. The bias of approach has left its mark in the inconclusiveness of economic discussion, in the lack of agreement as to what is settled and what is not, and even in the question as to what the real scope and aims of economics are. Under the term "progress of nations" we include a complex group of forces. When we come to weigh them out one by one, it will appear that the greatest motive force in the

[1] Address of the retiring vice-president of Section I at the Baltimore meeting of the American Association for the Advancement of Science.

unfolding of material power in modern times has been that of the various sciences. In fact, it is this leavening of our western civilization with the knowledge and power of the natural sciences, in their mastery over the forces of nature in the service of man, that, more than any other single criterion, marks off modernity from all that goes before it.

SERVICES OF GEOGRAPHY AND ASTRONOMY

Historically speaking, the earliest of modern sciences to affect the nature and scope of investment was geography. The European explorations and discoveries of the fourteenth and fifteenth centuries added an area of territory to the field of commerce, probably three times the size of that known to western Europe prior to the rounding of Africa, the opening of a sea-route to India, and the discovery of the American continent. Then followed the formation of the great trading corporations, of which the East India Company was typical. These corporations broadened out into the colonial policies of western Europe, in the effort to exploit the lands thus discovered for the enrichment of the home countries. Thus in the short period of a single century the map of the entire world had changed, almost beyond recognition—all because the science of geography had enabled the researchful spirits of those times to pass from the confines of the known out into the unknown.

The next of the sciences to influence the progress of modern investment was astronomy. It was by the aid of the science of the heavenly bodies that ocean navigation was rendered possible. It is not too much to say that the annexation of the oceans to the world's area of free enterprise was, next to the discovery of America, the one thing that had most to do with making modern nations what they are in things material. On this basis of maritime traffic, nine tenths of the world's international trade rests. The sea is as vital to Great Britain, and nearly as vital to the national life of Germany, as food is to the body. And yet, without the contributions of astronomy the commerce of the world, which normally among the nations exceeds $25,000,000,000 a year, would be little more than a coasting trade, whose vessels hug in fear the shores of inland seas and the ocean frontages of their own countries.

These two sciences—geography and astronomy—together put into the hands of man the powers whereby he, within a comparatively short period of time, enlarged the extent of the world's market by three times its earlier area and taught men the art of mastering maritime transportation, thus connecting the world's continents by highways over a field of intercourse covering three fourths of the area of the globe. These sciences, when yet in their infancy, laid the foundations of the commercial, industrial and financial powers whose wealth has since assumed proportions so colossal as to stagger the vividest imagination.

METALLURGY AND THE RÉGIME OF MONEY

The next group of sciences which have radically influenced the course of modern enterprise and investment is that which includes the production and the manufacture of metals. Mining and metallurgy put the old world in possession of the precious metals of the new. The infusion of metallic money in such unheard-of quantities into the economic life of Europe was one of the most revolutionary forces that ever came to any age. There was not a single institution, social relation or business contract that did not undergo radical transformation, by virtue of the effect of the precious metals upon the laborer and the employer, the state and the subject, the debtor and the creditor. The precious metals put the monetary systems of the na-

tions on a metallic basis and thus for the first time gave to them a common standard of international value.

Thus far the three distinct contributions of the sciences to the economic factors that go to make up the modern world market are: (1) The discovery of new lands, (2) the utilization of ocean transportation—the cheapest known and (3) an international standard of value. These three things have determined the plane on which investment activity in its most comprehensive scope is still working out its various problems under the guidance and direction of the sciences of geology, chemistry, physics and engineering.

SCIENCES IN SELECTION AND SUBSTITUTION

Possibly the most signal contribution of geology to the advance of investment is seen in the service which national and state surveys render to the development of natural resources. Each of the American commonwealths now regards such an inventory of the earth's formations and composition as geology alone can give as the indispensable condition of inducing capital to seek profitable employment within its borders. Investment of to-day is itself specialized in such a way that it depends upon the specialist's most complete researches to ascertain beforehand the wisdom or the unwisdom of putting capital of any given amount into an enterprise, as well as of locating it with due regard to the assemblage of the materials of production and to the expenses of marketing the products. Geological data determine in large part the answer to these questions. The state survey of the clays of New Jersey decided the location of a large pottery works at the city of Trenton —a point which had ample beds of the chief raw materials, but which also had the advantage of being half way between two cities of over a million population, yet not a hundred miles apart.

Thus the sciences, besides encompassing the globe to determine where nature has hid her treasures, determines where lines of transportation shall be laid down, where population is destined to concentrate, and in what particular channels of employment both labor and capital may find the maximum returns. In other words, science is a function of economic progress, operating under the law of substitution. According to that law, the fall of the rate of profits impels the producer of commodities to find some less expensive substitute among the articles that make up the elements of the cost of production. In the other direction, the making of extraordinary profits may effectively impel the producer to escape the limitation of supplies which keep him from entering on large-scale production, thus multiplying his profits manifold. The burden of discovering what might serve as economical substitutes falls upon the scientific laboratory.

EVOLUTION OF MACHINE INDUSTRY AND TRANSPORTATION

The chemical and physical laboratory constitute the experimental and exploring arm of the up-to-date industry. The railroad must have it to test its materials. The manufacturer must have it to insure himself, not only against deliveries of inferior materials in contract, but even more so to enable him promptly to test the applicability of any new discovery to his business, to decide as to whether or not there is any advantage to him in changing his methods, and to put to test his finished product before it is sent out, thus detecting any defect in construction which actual use might disclose.

Not only has science made industry and commerce more technical, calling progressively for a more highly skilled and a more varied class of labor and talent, but it has without doubt been the chief factor in differentiating modern industry and com-

merce from the handicraft state in the one case and from the primitive forms of transportation on the other. I put it approximately near the truth in saying that machine industry, meaning all work done by mechanical power, would have been impossible but for the use which has been made of physics, chemistry and mechanics in the evolution of the modern system of production and commercial distribution. These three sciences, for instance, share the honor of achievement in the development of the steel rail on our railroads, from the strip of soft iron strung on a pair of parallel girders to a self-sufficient iron rail resting on cross-ties, into the present-day steel rail weighing 100 pounds to the yard. Here we have chemistry, physics, mechanics and metallurgy working conjointly toward an end, which has in turn become the point of departure for a series of developments in the more economical handling of freight. Cutting down costs and increasing carrying capacity have followed the path along which the sciences have led at every stage, in a railway system now representing an investment of $20,000,000,000 in the United States alone.

ENGINEERING AND PUBLIC SERVICE

I need hardly remind you that the most rapid strides among investment activities have indeed been made by those in which science has had the largest sway. These are the fields in which engineering has applied the sciences to profitable uses. One's mind naturally turns to the various enterprises in which electrical power has a domain of its own. Communication, illumination and transportation—three fundamental necessaries of modern living have opened fields of almost unlimited investment possibilities. In all of them, whether it concerns the telephone or the lighting and power problem, the lines of responsible relations with the public are being gradually lain down on safer bases. The popular appreciation of mutual approach to common understanding has already been developed in scores of public service corporations, far beyond the needs of public subscription to capital requirements. The very faith aroused in the soundness of these agencies is an asset of no mean significance in proving the profitableness of their investments.

SCIENTIFIC BASES OF LARGE-SCALE INDUSTRY

It is not usually recognized that science puts a premium on the large-scale industry as compared with the smaller undertaking. The latter can not always afford the expense of maintaining experimental work. The advantage would even be doubtful if it could. But with the consolidation of industries under a central management, the scope of scientific possibilities becomes immensely enlarged. Experiments which demonstrate better results for one plant can immediately be appropriated by all. By the exact measurements of methods and results in one establishment the efficiency of all the others can be tested. This indicates one of the ways in which the sciences have contributed toward the concentration of control and the enormous capitalization of the industrial combinations known as the trusts.

Science in this case pointed out the enormous wastes of so large a number of independent establishments, and helped to measure the extent of economies possible under unified control guided by scientific foresight. We may regret the resulting change. We may even fear for the future of popular welfare in a régime of apparently impregnable combinations. But one thing is sure as fate—and that is this: So far as these consolidations are founded upon scientific bases and remain there, their origin, development and future are assured. But so far as they have had an

artificial and unscientific conception, say in the greed of monopoly, and have vaunted themselves with pride of power unbalanced by the laws of nature, to that extent have they implanted in them the seeds of economic death.

Darwin tells us that for survival two factors are necessary—continuity of type and adaptation to the conditions of existence. Now the work of science in the world's evolution of the type of industry which makes for the maximum general welfare is to increase the degree of adaptability so that the historic type may have the greatest facility of adjustment to actual and prospective needs. Size is the condition of survival. But size uncemented by the scientific spirit, unchartered on the sea of enterprise by the directing captaincy of research, is either doomed to wreck or dry rot. The rise of the corporation, in which form free capital now seeks its widest investment, is the outcome of a search for a type of industrial organization in which the science of the laboratory and the savings of the people may be incorporated under responsible management.

FOUR CRITERIA OF CORPORATE SURVIVAL

This brings me to the point of stating the criteria of survival and development to which the modern business corporation must conform. For I think we all recognize that, although under corporate form, the western world has made unparalleled progress in investment, still the main purposes of investment, namely, personal profit and popular well-being, will not, at this stage of the world's democracy, consent to sacrifice the latter wholly for the former. The corporation will survive only as it serves its function of economic progress, both by being a better producer of wealth out of natural resources and by being a better distributor of wealth, once created, as a product of the unified resources of the community. In short, the corporation as an investment institution gathers into itself the surplus resources of the people, on the at least implied promise of bringing them better returns for its use than they can win working alone. The fulfillment of that obligation, whether regarded as moral or legal, is possible only on condition that it meet to a reasonable degree four distinct criteria of business experience.

Investment within each particular field must no longer hazard the certainty of the outcome on individual management divorced from contact with those who furnished the means necessary to bring labor and capital together under responsible control and cooperation. That business management of entrusted capital may enjoy the certitudes of regular returns it must rest upon scientific, not individual, foundations. Thus will investment of popular savings be lifted out of the boggy ways of speculative risks and be raised to the level of demonstration.

First of all, then, the type of investment institution that will meet modern conditions of existence must be *scientific*, in that it must follow the path of demonstrated safety as marked out by scientific research. Secondly, the management of such an institution must be a *responsible* one, in the sense of being morally and technically aware of its rights, duties and possibilities. Thirdly, under existing scarcity of capital the world over, and with the prevailing degree of dependence upon the comparatively small investor, the type of investment organization which prevails will have to be *popular*. It will have to appeal to the confidence of the people effectively enough to draw from them necessary capital, not only for initial investment, but for subsequent doses for extension and development. Fourthly and finally, it goes without saying, that any investment agency

which popular judgment will not destroy will have to be *profitable*.

JOHN FRANKLIN CROWELL

A PLEA FOR TERRESTRIAL AND COSMICAL PHYSICS[1]

ONCE upon a time, at a certain small dinner-party, the Duke of Wellington, on being urged to express his opinion frankly of the French marshals he had so successfully worsted in battle, pointed out their good qualities in a most free and magnanimous manner, showing wherein each particularly excelled. Whereupon one of the party said: "Well, sir, how was it that with such various great qualifications you licked them all, one after another?" The duke, taken back, paused, then said: "Well, I don't know exactly how it was, but I think if any unexpected circumstance occurred in the midst of a battle which deranged its whole plan, I could perhaps organize another plan more quickly than most of them."

This power of being able to instantly change an established train of thought, or to be receptive to a new set of circumstances and facts, and thus to be capable of immediately setting up a fresh plan of action, was tersely and most suggestively expressed by Maxwell. When writing Herbert Spencer about a subject of controversy in the latter's "First Principles," he said:

> It is seldom that any man who tries to form a system can prevent the system from forming around him, and closing him in before he is forty. Hence the wisdom of putting in some ingredient to prevent crystallization and keep the system in a colloidal condition.

At the Ithaca meeting of the association, two years ago last summer, I prefaced a paper on the San Francisco earthquake by a few remarks calling attention to the disparity of papers pertaining to the physics of the earth and of the universe presented to-day before sections A and B. I stated it was my impression that this had not always been the case. Attend any similar meeting abroad, be it in England, Germany or France, and you are apt to find the names of foremost physicists down for papers on results of research in terrestrial or cosmical physics. These eminent investigators evidently find food for exhilarating thought and stimulating work in the unraveling of the phenomena of seismology, meteorology, geodesy, hydrology, atmospheric electricity, solar physics, terrestrial magnetism, etc. They appear to regard knowledge gained in the laboratory and in the university merely as a means to an end, not an end in themselves.

The chairman of the Section of Mathematics and Physics at the recent meeting of the British Association was the well-known physicist-meteorologist, Dr. W. N. Shaw, director of the London Meteorological Office. Besides making a most suggestive presidential address, he led an interesting discussion on "The Isothermal Layer of the Atmosphere"—a live topic in meteorology to-day. Those taking part in the discussion were: Shaw, Rotch, Dines, Cave, Turner, J. J. Thomson, Walker and others. Several times has it occurred within recent years at that association, that, owing to the number of titles presented, it was necessary to have a subsection on "Cosmical Physics" which I am very glad to note did not apparently meet with the favor of the physicists themselves. Our British colleagues want the cosmical physicists to stay with them and not flock off by themselves, and the present tendency seems, accordingly, to be at the British Association, not to form such a subsection. Indeed, Dr. Shaw, in the address referred to, said:

[1] Presented at the Baltimore meeting of the American Association for the Advancement of Science, at the general interest meeting of the Section on Physics, December 30, 1908.

For the advancement of science in this sense we require all three—the professor with academic freedom, to illuminate with his genius any phenomenon which he may be pleased to investigate, the administrator, face to face with the practical problems in which science can help, and the living voice which can tune itself in harmony with the advances of science and in sympathy with the needs of the people whom it serves.

You will find among the past contributors to papers and discussions on the subjects mentioned, such names as, Kelvin, Rücker, Schuster, Lockyer, Eliot, Cortie, Teisserenc de Bort, Glazebrook, Chree, Gill, Thomson, etc.

I can not better illustrate the mutual help that may spring from friendly conference between the pure physicist and the world-inoculated one than to quote you a paragraph or two from a most admirable presidential address delivered by Dr. S. Weir Mitchell, at the second meeting of the Congress of American Physicians and Surgeons, held at Washington in 1891, entitled, "The Early History of Instrumental Precision in Medicine." Referring to this congress of the eminent of the land in medicine and surgery, Dr. Mitchell says:

It is here, therefore, that the open-minded man may feel the broadening influence of intellectual contact with those who have other limitations than his own; for, indeed, in our divergent attention to special studies we run some risk that, contrary to St. Paul, the eye may say to the hand, "I have no need of thee," or the head to the body, "I have no need of thee," for as to us also, there should be no schism in the body. . . .

What the specialist learns, until it is commonplace, is not easily enough assimilated by the mass of practitioners. At last, however, comes a time when it is, and then that whole body of medicine feels the gain in nutrition and repays the debt. The masters of our still most perfect art, medical optics, may wisely remember that it was physicians who most distinctively recognized and diffused the knowledge that headaches and some other brain disorders are due to eye strain, and thus, while lessening our own futile labors, crowded the waiting room of the ophthalmologist. . . .

As I have mentioned the need for continuous individual cultivation of our multifarious science on a broad scale, and for personal consultation, I like to enlarge the plea and call a meeting like ours a general consultation. And this, in fact, it is; a focal point for condensed opinion, for authoritative statements, for criticism from varied standpoints and for significant indications as to those accepted gains which ought to become, from time to time, a part of the mental equipment of all other special, and indeed of all general practitioners.

Change the words physician, surgeon, medicine, to corresponding ones applicable to this gathering, and what apter or truer characterization of what our own aims and purposes should be could be given than is embodied in these words! One is tempted to wish that we might also, like the "Deutscher Naturforscher und Ärzte Versammlung" of Germany, gather with us in annual conclave the physicians and surgeons as well. Picture to yourselves the opportunities this would afford for enlivening and quickening discussions in several of our sections, and you will appreciate what I am seeking to emphasize, especially here, with regard to open, general meetings between the generalist and the "broadened" specialist. I say "broadened specialist" advisedly, for I believe upon critical examination it will frequently appear that the very pursuit of a speciality has a widening influence not adequately appreciated by one whose sphere of activity is restricted solely within the bounds of his own general science. For there is no more patent and suggestive fact of present-day research than that the most notable and the most rapid achievements are not in the older, well-recognized sciences, but in their borderlands or "twilight zones." Thus the true research worker soon finds it necessary to make excursions into regions beyond what he had been regarding as his own particular zone. He makes new acquaintances, learns new customs and laws and gradually begins to

perceive that there really is no well-defined line of demarcation—like the famous Great Wall of China—between one science or another!

One of the recent fundamental researches on the "Motions of the Moon" has been made by a college professor who, though an American resident, got his chief training and inspiration at Cambridge, England. This same investigator has contributed articles on meteorological mechanics. Columbia University, in its admirable endeavor to present a popular course of lectures on subjects of applied physical science, must draw for its lecture on "Atmospheric Phenomena and Physical Theory" upon another foreign-born, Cambridge-inspired, now American resident mathematical physicist. There are several of you here whose work lends additional eloquent testimony to the broadening and cosmical influence of that eminent school of physics. However, there are other European departments of physics of which much along similar lines could be stated and exemplified. Is it not possible to have more home-inspired university product of our own to draw upon in these fields? Shouldn't we strive that our country be adequately represented on international committees formed to consider and to investigate some of the great world-wide questions? I believe we do not lack the talent. If there is less incentive among us, why is it?

The fact I wish to emphasize is strikingly shown by glancing for a moment at the general character of the programs presented in the first two decades of the association's history before the section on general physical science. The papers classified under physics of the globe, meteorology, geodesy and navigation, frequently exceeded those in physics, chemistry, mathematics and astronomy, whereas now, as you all know, they are in a minority. Among the authors of the first-named papers we find names which as soon as heard you will identify as among the most distinguished of the college professors of the middle of the last century: Redfield, Bache, Olmsted, Coffin, Alexander, Henry, Silliman, Peirce, Loomis, Espy, Horsford, Guyot, Lovering, Dana, Trowbridge, Mitchell, etc. Among the more eminent of those occupying government positions we find again Henry and Bache, and such men as Maury, Davis, Hunt, Hilgard, Schott, etc. The mental grasp of many of these geo- and cosmical physicists was considered sufficiently broad to make them desirable timber for the highest positions of honor in the association.

In those "good old days" some of the best contributions in meteorology and terrestrial magnetism were made by the college professor. Bache made a magnetic survey of Pennsylvania early in the forties while still a professor at Girard College, where he also established the first magnetic observatory in this country. John Locke, the inventor of the electro-chronograph (which, by the way, is unique in the history of science in this country as being the only scientific invention, I believe, receiving an award from our Congress, viz., $10,000), in the thirties and forties undertook a magnetic survey of North America with Cincinnati as a base station. He even extended his investigations into Canadian territory and made many of the early observations of the three magnetic elements in the eastern states. Locke was a contemporary of the astronomer Mitchel, holding the chair of professor of chemistry and pharmacy at the Ohio Medical College. He lived at the time when the college professor frequently had to acquire his instruments of research and pay the expenses of his experiments out of his own meager salary. Yet he found ways of doing it and, moreover, had the necessary time to

go beyond his class-room and extend his good work in the territory round about and far away.

Loomis's work on the aurora borealis is still quoted. The contributions to meteorology by Espy, Redfield, Coffin, Maury and Loomis are even known to those of us who do not profess to be meteorologists. These few illustrations must suffice for our present purpose.

If the college professor now lacks the necessary time and incentive during the scholastic year, let him follow the example of Locke, Bache or Nipher who spent their vacations in the open in order to learn something of the physical laws governing natural phenomena. Let him behold his colleagues abroad like Rücker and Thorpe—one a physicist, the other a chemist—who jointly made a magnetic survey of the British Isles during their vacations with the aid of grants which probably just covered expenses and with doubtless no remuneration. The eminent Japanese physicist, Tanakadate, is another instance in point.

Why is it that, in spite of the truly wonderful spirit of research that has literally *seized* us in this country, there are so few of us entitled to be enrolled among those who are making definite contributions to terrestrial and cosmical physics?

We note with pleasure that the American physicist is very prominently represented, indeed, in astronomy and astrophysics. May we not hope that he will soon realize that this planet on which we dwell, and which must form the basis of all our astronomical speculations, is also worthy of the highest and most unselfish devotion? That, indeed, to reap the full and most lasting benefit of our celestial researches we must keep equal pace with our terrestrial ones? Let him recall that nearly every one of the great physicists has at one time or another extended his mental vision beyond the problems immediately before him and considered what the application of his laboratory discoveries might be towards solving some of the riddles of the universe, or how he might benefit mankind. Faraday, Maxwell, Kelvin, von Helmholtz, Hertz, Mascart, Langley and Rowland are but a few of the inspiring names.

Happily, there are already some indications of a reawakening, and we note with pleasure the example recently set by our retiring president, who turned his sabbatical year to fruitful use in the study of some perplexing atmospheric phenomena. We note movements at some of our large universities to expand their graduate courses in the direction of the applied science here had in mind. At the present meeting we find 12 papers before Sections A and B, which might properly be classified under terrestrial and cosmical physics.

Von Helmholtz, as many of you know from actual experience, was a notoriously poor lecturer. He seemed utterly incapable of imparting his vast knowledge in any systematic manner, and doubtless the chief value which his listeners got was the inspiration imparted by class-room association with this gifted man. Von Bezold, who delivered the Berlin memorial address on von Helmholtz, told me the latter gave as the reason of his inability to impart his acquired knowledge methodically, the fact that he himself had not gained it in that way. He would take up his mathematics, for example, only when he required it—not by going systematically and consistently through a volume of higher analysis without some impelling or suggesting motive. And so it was with the other sciences with which he had to familiarize himself to push to successful completion an intricate and complex piece of research. Yet how

truly marvelous was the grasp this man displayed in so many varied subjects!

Now who has ever attempted to apply his knowledge to fields outside his own immediate one that has not felt this same irresistible, impelling, burning desire to know all that has been done before him in the new country he is about to explore? Haven't we each one of us found that with such an all-conquering impetus back of us the most complex mathematics or the most abstruse subject teems with a new and living interest? What was irksome before has now become a pleasure! And if there is one of you who for lack of excursions into such green pastures has not had new and invigorating blood course through his veins and has not been given a glimpse of a higher, truer and more ennobling vision of life, he has missed the greatest pleasure and the highest compensation open to the research worker!

Do you know of a school of thought that has prevailed for any length of time without resistance to that most subtle and, therefore, most dangerous of all insidious modes of attack, viz., the one coming from within its own fold of devotees, due to the pernicious habit of in-breeding? Is there any greater danger than that which besets a university which fills its chairs repeatedly from among its own graduates? We all know of the fallacy of the brilliant professor who thinks his ideas can be made to continue longest by surrounding himself with assistants drawn, if not entirely, at least chiefly, from among his own disciples. Will he not surely find, as Maxwell put it, that his "system has closed him in before he is forty" because he has forgotten the essential element to prevent crystallization —the importation of fresh blood and the introduction of new ideas?

If you agree with the speaker thus far, may not similar occurrences be recorded of our societies, because of the suicidal policy of a particular class of members who are apt to believe that the best result can be reached by increasing their representation, and thus by their majority vote be able to dictate and control the general policy of the society to which they belong? Is it wise organization for membership in any deliberative body to be so constituted as to make it possible for the act of the assembly to be unduly influenced by one set of investigators? Is there not here subject for careful thought—a source of degeneracy due to the in-breeding in societies to be equally guarded against? Joseph Henry truly said: "Votes in science should not be counted, but *weighed!*"

This then is my specific plea: a broader conception and a more scientific representation of the subjects of physical research. Could we not make the attempt certainly once a year to devote most of our time and attention to some of the greater aspects of our work and take stock, so to speak, of our achievements, and of their possible applications?

L. A. Bauer

REPORT OF THE COMMITTEE OF THE AMERICAN CHEMICAL SOCIETY APPOINTED TO COOPERATE WITH THE NATIONAL CONSERVATION COMMISSION

In May, 1908, a meeting of the governors of the different states was held at the White House in Washington to consider the conservation of our rapidly wasting natural resources. Following this meeting, a commission was appointed by the president of the United States to investigate the subject, and the principal scientific societies of the United States were invited to cooperate with it. The committee of the American Chemical Society, appointed in response to this invitation, now has the honor to submit the following preliminary report.

On December 8, 9 and 10 the National Conservation Commission met in Washington in joint conference with the delegates of

other organizations and the governors of more than twenty states. The commission, in its elaborate investigations, had, so to speak, taken stock of our natural resources, and its report, therefore, was essentially statistical in character. It had estimated the magnitude of each particular resource, and had studied the rate of consumption of such substances as lumber, coal, iron, etc. It discussed the wastage of the land by preventable erosion, and its effects not only upon agriculture but also in reducing the navigability of streams. Questions like these were treated at considerable length, and their general character is all that need be mentioned just here. The data of the commission were mainly classified under four headings, namely, minerals, forests, lands and waters, and under each one the evils to be remedied were pointed out with all the emphasis and clearness which the statistical method of investigation made possible. The commission cleared the ground for study into the prevention or limitation of future waste; and the problem of conservation can now be taken up in a more intelligent manner than has been possible hitherto. We now know better than ever before what the evils and dangers really are; the next step is to discover remedies, and then, finally, to apply them. The public attention has been aroused; the people of the country are awakening to the necessity of greater prudence and economy in the use of our resources, and definite lines of action can now be laid down with a reasonable probability that they will be followed. Fortunately the reports of the commission are neither sensational nor unduly pessimistic; the results of their conferences are presented seriously, and in such a manner as to compel consideration; they are therefore all the more likely to produce permanent effects of great benefit to the American people. The utterances of the mere alarmist rarely carry conviction; but disclosures like these made by the Conservation Commission can not be disregarded.

Up to the present moment chemistry has had little to do with the investigations of the commission. Henceforward the chemist must be called upon in many ways, for the waste of resources is often preventable by chemical agencies. Chemistry has already done enough to prove its potency, and its influence is felt in every branch of industry. Adopting the classification of the commission, we shall find the chemist active under every heading. Under minerals, we must note that metallurgy is essentially a group of chemical processes by which the metals are separated from the ores; a separation which may be either wasteful or economical. Within recent years, within the memory of members of this society, the available wealth of the world in metals has been enormously increased. By the cyanide process for extracting gold, ores are now profitably worked which were formerly worthless, and at the same time the demand for mercury has been decreased. The Bessemer process for steel making, now also modified for use in copper smelting, is purely chemical; and its later modification, the Gilchrist-Thomas process, applies similar principles to phosphatic ores, which were previously of little value. Furthermore, in the last-named process, phosphatic slag is produced, which is useful as a fertilizer and helps to relieve the drain upon our rapidly wasting supplies of phosphate rock. Chemists are now studying, with much success, the problem of preventing corrosion in iron, a research which will prolong the life of iron structures and thereby reduce the waste of ore. The use of coal slack by briquetting methods is largely based upon chemical investigations; the salvage of by-products from coke ovens, such as tar and ammonia, is wholly due to chemical research; coal is further economized by the study of boiler waters and the consequent prevention of boiler scale. Even inferior coals, lignites, are now converted into what is known as producer gas, and so are transformed into the best kind of fuel. Petroleum is refined by chemical means, and every fraction of it is saved, either as illuminating oil, as gasoline, as a lubricant, as vaseline, or as paraffin. These are all notable achievements, but greater are yet to come. Enormous quantities of valuable substances are thrown into

the atmosphere in fumes from smelters, which should, and probably can be, partly saved. Electro-chemistry is rapidly developing a large group of new industries, making such metals as aluminum, magnesium and calcium available for use, and it is reaching out into other fields of electrometallurgy in which electric heat, generated by water power, will be used for smelting other metals, thereby reducing the consumption of coal.

In forestry also, the influence of the chemist is distinctly felt. The sprays, used for destroying noxious insects, are chemical preparations. The manufacture of wood alcohol is a chemical process, which may be either wasteful or economical. Turpentine is now produced wastefully, but the waste can be diminished by careful refining, and furthermore, the chemist can aid in discovering substitutes for it. Substitutes for tan bark are also to be sought for by means of chemical investigations. Another distinctively chemical operation is the preparation of wood pulp for paper making, a process which is now wasteful in the highest degree. It is estimated that for every ton of pulp now made by the sulphite process more than a ton of waste material is allowed to drain away into our streams. How to make this material useful is a chemical problem, and so also, in great part, is the investigation of other, now useless fibers, which may replace the more valuable wood. The preservation of wood from decay is still another art in which chemistry is predominant.

In preserving the fertility of our land, chemistry has an important part to play. Our knowledge of fertilizers, of the food on which crops can thrive, is entirely chemical so far as accuracy is concerned, and must be applied in accordance with chemical principles. A fertilizer which is useless, and therefore wasted on one soil, may be needed on another. Certain fertilizers, like the Stassfurt salts, Peruvian guano, the Chilean nitrates, and phosphate rock are limited in quantity, and their future exhaustion must be considered now. What shall replace them in the future? Already processes have been devised for fixing the nitrogen of the atmosphere and rendering it available for plant food. Saltpeter and other nitrates can be and long have been made from waste materials such as old mortar and animal refuse. The phosphatic slags have been mentioned in connection with metallurgical processes. These sources of fertility are important, but greater still is the source found in our municipal sewage. The problem of its salvage has been worked out in some localities, but in the United States the people are only beginning to be aroused to its importance. Enormous masses of material, easily available for fertilizing purposes, now drain into our rivers or directly into the sea. Another question, now under investigation, is the possibility of using our common feldspathic rocks in fine powder, to replace the potassium withdrawn by plants from the soil. The relations between the chemical composition of water and the conservation of natural resources are of intimate and fundamental importance and some of them have been mentioned under other headings. The rate at which the land surface of the United States is being transported to tide water has recently been estimated by means of chemical analyses of river water coupled with determinations of stream flow, and the results of the computations will doubtless assist considerably in studying soil erosion and the impoverishment of agricultural lands. In steam making the chemical quality of the water supply is an appreciable factor in fuel consumption, a subject to which reference has already been made. The scale that forms on the boiler shell and tubes, when water containing incrustants is used, is a poor conductor of heat and, consequently, causes increased expense for fuel. By detailed study of the chemical composition of available boiler waters, it is possible to select a supply having a minimum amount of incrusting, corrosive and foaming constituents, thereby effecting appreciable economy in fuel. Chemical investigation of methods for purifying water supplies, not only for boilers but for paper manufacture, soap-making, and other great water-consuming industries, will enable man-

ufacturers to make new and greater saving in many raw materials other than fuel.

Stream pollution by industrial refuse and by sewage is a source of enormous waste in our natural resources. The subject has been for many years a field of research for industrial, sanitary and biological chemists in the United States, and their investigations have resulted in the improvement of manufacturing processes, the utilization of wastes, the purification of sewage, and the protection of domestic water supplies. When the presence of deleterious substances in our river and lake waters has caused loss of fish life and the destruction of oyster beds, the chemist and the biologist have detected the harmful ingredients and have suggested methods for their removal. River silt, an important source of detriment to navigation, is also estimated by the chemist. It has been fully demonstrated that the prevention of stream pollution lies not alone through injunctions and other legal proscriptions but also in using waste materials or, when that is not possible, in rendering them harmless. The chemist has much to do in protecting and preserving the quality of our water supply. Upon that, in very great measure, depends the preservation of our highest resource, human life. Polluted waters distribute typhoid fever and other dangerous diseases, and so cause losses which should be, and really are, preventable.

The foregoing illustrations are enough to show, for present purposes, the intimate connection between chemistry and the study of conservation. They also bring out the fact that the classification adopted by the national commission, although admirable for statistical research, is not final, and that it needs to be supplemented by a different subdivision of the data. The facts to be investigated often fall under more than one heading of the classification, and actually interlock in every conceivable manner. To operate a placer mine, for example, abundant water is needed, while a deep mine requires timber for its shafts and levels. In building and occupying a house one covers land, uses lumber, brick, stone, and iron, introduces water supply, and burns fuel. In short, every phase of the conservation question affects the interests of everybody. If the investigation of our natural resources is to be made effective, it must be applied to individual industries, and in order to do that another scheme of classification would seem to be necessary. Such a scheme we venture to outline, but very briefly.

At the outset the problem can be divided into two parts, one relating to sources of energy, the other to material substances. The two are not really separable, but may advantageously be considered separately.

In the first place, the energy available for industrial uses may be classified under three heads, as follows: First, inexhaustible energy, such as solar radiation, wind power, tidal power and, with certain limitations, the power furnished by flowing streams. Second, reproducible or renewable energy, like the power supplied by horses and other domestic animals. Wood, regarded as fuel, also falls under this heading, for forests can be artificially grown. Third, the exhaustible energy represented by mineral fuel, like natural gas, petroleum, and coal, which, once used, is gone forever. Under this classification the practical problems are, to economize the exhaustible energy, to encourage the development of renewable energy, and to discover new methods of using the inexhaustible energy.

Exactly the same classification applies to material substances. Some, like sea salt, limestone and clay are, humanly speaking, inexhaustible. Agricultural and forest products are reproducible, some of them year by year. The metallic ores and such useful minerals as phosphate rock are, however, exhaustible, and need to be conserved.

With the aid of this very simple classification it becomes possible to analyze a specific industrial problem in such a manner as to make evident its factors of waste or economy. For example, sea salt is inexhaustible, and may be extracted by solar evaporation, which is a use of inexhaustible energy. Agricultural products are renewable, and their production chiefly requires the renewable energy of men and animals. But the smelting of

metallic ores, as now conducted, involves the use of exhaustible material both as ore and as fuel.

In most industries, however, the two sets of considerations are combined. Portland cement, for example, is made from inexhaustible substances, but is burned with exhaustible fuel. The latter factor in the industry, therefore, is the one to be carefully considered, while the first factor is negligible. Taking industry by industry we shall find that this condition of affairs is general, and that each one must be studied by itself with reference to its inexhaustible, reproducible and exhaustible elements. In doing this a clear notion can be obtained as to the real needs of a given industry, and our attention can then be concentrated upon those features of it which particularly demand economy. We shall be able to locate evils with greater accuracy; to diagnose the industrial diseases, so to speak, and then to look intelligently for remedies. Many of the remedies must be sought for along chemical lines of research, which will develop economical processes of manufacture, utilize materials that are now wasted, or substitute cheap for costly substances. Cheap and costly, however, are words which need qualification. A substance or a process which is cheap to-day may be in reality wasteful with a temporary reduction in price at the cost of some permanent economy. For our purposes the two words imply a deeper discrimination than is carried by their ordinary use. Temporary efficiency and cheapness are to be discountenanced, while permanent economy for the benefit, not only of the nation but of the whole human race, is to be encouraged. This principle is sound, but its practical applications will involve many difficulties, and develop many conflicts with special interests. Like all ideals it can not be realized absolutely, but it represents a standard of action towards which we must move, even though the ultimate goal of perfection may never be attained. Evils can be mitigated, although they may not be entirely removed.

The American Chemical Society now numbers more than four thousand members, scattered through all the states and territories of the union and represented in every one of our great productive industries. These chemists are at the same time progressive and conservative in their work, for they are both discovering new utilities and protecting old ones from loss. We believe that every member of the organization is necessarily in sympathy with the great forward movement for economy, and that in our society the National Conservation Commission will find a most powerful and willing ally.

F. W. CLARKE,
H. W. WILEY,
C. H. HERTY,
S. W. PARR,
R. B. DOLE

SCIENTIFIC NOTES AND NEWS

THE Royal Academy of Stockholm has presented Mr. Thomas A. Edison with its Adelskiold gold medal for his inventions in connection with the phonograph and the incandescent light. This medal is conferred once in ten years.

PROFESSOR CLEVELAND ABBE, of the U. S. Weather Bureau, has been elected an honorary member of the Royal Meteorological Society.

THE Alumni Association of Columbia College and the School of Mines gave a dinner to Dean J. H. Van Amringe, professor of mathematics in Columbia University, on April 3, to celebrate his birthday and a half century of teaching at Columbia College. A loving cup was presented to him.

IT is announced that President Taft has requested Surgeon General Wyman to draw up a tentative plan for the consolidation under one bureau of the agencies exercised by the federal government for the preservation of the public health.

M. JUNGFLEISCH has been elected a member of the Paris Academy of Sciences in the section of chemistry as successor to the late M. Ditte.

MR. CHARLES S. SHERRINGTON, professor of physiology in Liverpool University and Mr. William H. Maw, editor of *Engineering*, are

to receive the doctorate of laws from Glasgow University.

THE Chemical Society, London, has conferred its Longstaff medal on Professor S. F. Kipping, of University College, Nottingham.

PROFESSOR HAROLD DIXON has been elected president of the Chemical Society, London, succeeding Sir William Ramsay.

AT the sixty-second annual meeting of the Paleontographical Society, held in the rooms of the Geological Society, London, on March 19, Dr. Henry Woodward was reelected president, Dr. G. J. Hinde, treasurer, and Dr. A. Smith Woodward, secretary. Sir Archibald Geikie, was elected a vice-president in succession to the late Mr. W. H. Hudleston.

PROFESSOR THOMAS PURDIE will retire at the end of the summer session from the chair of chemistry at St. Andrews, owing to ill-health.

THE Isaac Newton studentship at Cambridge University, tenable to April 15, 1812, has been awarded to Mr. W. J. Harrison, of Clare College.

MR. N. W. THOMAS has been appointed government ethnologist to southern Nigeria.

DR. CAROLINE MCGILL, instructor in anatomy at the University of Missouri, has been awarded the Sarah Berliner research fellowship for women of the value of $1,200.

DR. PHILIP P. CALVERT, assistant professor of zoology in the University of Pennsylvania, will be given leave of absence, and his place will be filled next year by Dr. Merkel Henry Jacobs, who is now engaged in post-graduate study at the University of Berlin.

MR. J. R. JOHNSTON, of the Bureau of Plant Industry, returned recently from the vicinity of Baracoa, Cuba, where he has been engaged for some months in researches on the nature and possible control of the cocoanut bud-rot.

DR. VICTOR C. VAUGHAN, of the University of Michigan, will deliver the presidential address at the meeting of the Association of American Physicians to be held in Washington on May 11 and 12.

DR. A. C. LANE, state geologist of Michigan, gave a special lecture on "The Grain of Rocks," in the department of geology and a talk on the "First Evidences of Life on the Globe," to the Science Club, at the University of Wisconsin on March 26.

AT the meeting of the American Philosophical Society on March 19, Professor Marston T. Bogert, of Columbia University, gave an address entitled "On Coal Tar Products and their Application in the Arts and Medicine," which was illustrated by a large number of specimens.

MAJOR M. W. IRELAND, who is chairman of the committee appointed by the legislative council of the American Medical Association, to assist Mrs. Carroll, the widow of Major James Carroll, announces that $2,500 have been subscribed, chiefly by medical officers of the Army, the Navy and the Public Health and Marine Hospital Service. Though Mrs. Carroll was voted a pension of $125 a month, this does not suffice to support and educate her seven minor children; the aged mother of Major Carroll was also dependent on him. Subscriptions for the relief of Major Carroll's family and as a recognition of his heroic and distinguished services for the suppression of yellow fever may be sent to Major M. W. Ireland, Office of the Surgeon General, War Department, Washington, D. C.

DR. WILLIAM JONES was murdered, on March 28, by natives in the Philippine Islands, where he was carrying forward anthropological work on behalf of the Field Museum of Natural History of Chicago. Dr. Jones, who was partly of Shawnee Indian descent, studied at Harvard University and subsequently took the degree of doctor of philosophy at Columbia University. He was an accomplished anthropologist, and his death is a serious loss to the science of anthropology.

WILLIAM CHARLES KERNOT, professor of engineering in Melbourne University, has died at the age of sixty-four years.

FOLLOWING up the plan inaugurated by the section of geology and mineralogy of the New York Academy of Sciences last year, the mineralogical and geological section of the Academy of Natural Sciences of Philadelphia proposes to arrange for a second annual spring

meeting of the geologists of the northeastern United States, to be held in Philadelphia on Friday and Saturday, April 23 and 24, 1909. It is planned to hold two sessions for the reading of papers, and a field trip to typical localities of the Pre-Cambrian and early Paleozoic rocks of the region. It is hoped that every one will be able to contribute, if not an extended paper, at least an informal account of work being carried on. Titles should be sent to Professor E. T. Wherry, Lehigh University, South Bethlehem, Pa.

On Thursday evening, March 18, Dr. Barton W. Evermann, assistant in charge of scientific inquiry, Bureau of Fisheries, Washington, D. C., delivered a lecture to the members of the Massachusetts Fish and Game Protective Association and their invited guests at the Copley Square Hotel in Boston. His subject was "With Packtrain to the Tip-top of the United States in Quest of the Golden Trout," illustrated by numerous stereopticon slides. When it was reported to President Roosevelt that the golden trout, known only from Volcano Creek in the High Sierra of California, was in danger of extermination, he called upon U. S. Fish Commissioner Bowers to have an investigation made and Dr. Evermann was put in charge of the field party. The golden trout of Volcano Creek proved to be an undescribed species which has been named *Salmo roosevelti*. Another undescribed species was found in Soda Creek, a western tributary of the Kern; and it has been named *Salmo whitei*, in honor of Stewart Edward White, who suggested the investigations. The expenses of the lecture were paid from the income of the "Ivers Whitney Adams Fund," a gift of $5,000 presented the association in 1908, by Mr. Ivers Whitney Adams, of Boston, "to secure and provide lectures to be given before the members of said association at regular or special meetings of each year, but not at annual banquets, said lectures to be illustrated, as far as practicable, and connected with the objects of the association."

The *Geographical Journal* states that in 1907 Professor Eberhard Fraas discovered an interesting fossil bed in the Upper Cretaceous formation of Tendagu, in the Linde district of German East Africa. This deposit contained a number of bones of Dinosaurs, the bones of these huge reptiles lying for the most part in their natural position in the marl and sandstone, from which they have weathered out so that they protrude at the surface. The specimens brought back by Professor Fraas are now mounted in the museum at Stuttgart, and have been shown to belong to a herbivorous Dinosaur which must have reached a length of about 48 feet, and has been named Gigantosaurus. The specimens are incomplete, and so much interest has been aroused by them that the German government has decided to send a special expedition to the region, to examine the deposit in detail, and to make additional collections of fossils.

The honorary secretaries of the Zoological Society of Scotland, which has recently been founded, inform *Nature* that the society has been formed for the purpose of establishing a living zoological collection and garden at Edinburgh. The garden will be arranged on the system adopted by Herr Hagenbeck, of Hamburg, and will be conducted on scientific lines. When the society has developed sufficiently, it is within its scope to establish branch gardens in the other large towns in Scotland. In addition to this, lectures of a popular nature by eminent zoologists will be arranged. The headquarters of the society, and the first and principal garden, will be at Edinburgh. To obtain the necessary capital a garden fund has been opened, to which donations are solicited. The annual subscription is £1 1s., but members who join the society during 1909 pay 10s. only for that year. This will entitle members to all the privileges usual in such a society. The aim of the promoters is to build up a strong society with a large membership, so that a considerable part of the annual sum required for the upkeep of the gardens will be insured from subscriptions, and less dependence will require to be placed on the receipts from the public for admission.

At the regular monthly meeting of the Biological Club of the Ohio State University on Monday evening, March 1, a special program in commemoration of the centenary of the birth of Charles Darwin was presented.

President William Oxley Thompson had consented to act as honorary chairman, but later found it impossible to be present, and Miss Freda Detmers, president of the club, presided. The program was intended to cover the various phases of Darwin's life work as the following list of subjects will indicate: "Darwin's Character and Method of Work," Professor F. L. Landacre; "The Influence of Darwin's Work in Geology," Professor G. D. Hubbard; "Darwin's Contributions to Zoological Science," Professor Herbert Osborn; "Darwin in His Relationship to British Stockmen," Professor C. S. Plumb; "Darwin's Contributions to Horticultural Science," Professor V. H. Davis; "The Work of Darwin in Physiological Botany," Professor A. Dachnowski; "Darwin's Contributions to Botany," Professor J. H. Schaffner; "Darwin and Modern Philosophy," Professor A. E. Davies; "Darwin and Modern Psychology," Professor D. R. Major.

UNIVERSITY AND EDUCATIONAL NEWS

THE appropriations committee of the Pennsylvania House of Representatives has reported a bill recommending an appropriation of $700,000 to the University of Pennsylvania.

IT is said that Dalhousie University is likely to be removed from Halifax, N. S., to the city of Dartmouth on the opposite side of the harbor. This city has offered a free site and about $100,000 for buildings.

THE governor of Colorado has signed a bill permitting the state university to conduct the last two years of its medical course in the city of Denver.

THERE has been introduced in the New York assembly a bill which provides that five members of the board of trustees of Cornell University shall be appointed by the governor, his appointments to be subject to the approval of the senate.

A ROYAL commission has been appointed to consider the position and organization of university education in London.

THE inauguration of Dr. Richard C. MacLaurin as president of the Massachusetts Institute of Technology will take place on Monday, June 7, at Symphony Hall. A committee of the corporation, faculty and alumni has been appointed to take charge of the ceremony.

MR. R. H. WHITBECK, of the New Jersey State Normal School, Trenton, N. J., has been appointed assistant professor of geology at the University of Wisconsin. He will give courses especially intended for the preparation of teachers, dealing primarily with applied geography and with materials available for secondary school teaching and methods of presenting physical geography, geography and geology.

DR. EDMUND LANDAU, docent at Berlin, has been appointed professor of mathematics at Göttingen.

DISCUSSION AND CORRESPONDENCE

CITY BOYS VERSUS COUNTRY BOYS

TO THE EDITOR OF SCIENCE: In your issue of February 12 Mr. W. J. Spillman, under the title "Education and the Trades," makes, with regard to the birthplaces of leading Americans, the following surprising statement:

> I believe there are some things which have higher pedagogic value than anything taught in our schools to-day, else why is it that with only 29 per cent. of our population actually living on the farm, with miserably poor school facilities as compared with our city population, this 29 per cent. furnishes about 70 per cent. of the leaders in every phase of activity in this country?

I say surprising, because any one who is familiar with modern investigations in the inheritance of mental qualities in man, must see that such a supposition, if it were indeed a fact, would seriously clash with the conclusions drawn from a number of researches otherwise harmonious and mutually supporting.

This point I will discuss later, but now let us test the facts. Does the farm produce more than its share of leading Americans? Such a question must be answered on a statistical, impartial, and as far as possible, scientific basis. It is first necessary to determine who are the "leaders in every phase of activity in this country." I have turned to "Who's

Who in America" to answer this question. This book has already been successfully used in several sociological studies, and has great value as a starting point for such researches. The editor doubtless tries to be as impartial and comprehensive as possible; but its greatest value to one who wishes to answer a question similar to the present discussion, is that here he finds a list of names prepared by some one else, without any idea or bias in relation to the investigator's present problem. Thus the first, and one of the most important requirements is obtained, the subjective element is eliminated.

Some will not be willing to accept conclusions draw from a list which like this doubtless has certain flagrant omissions, and where he sees names that he considers should not have been included. If he will stop for a moment and think, he will see that the very objection he raises only argues in the other direction from what he supposes. If, for instance, I find a marked correlation between city birth and more or less notable subsequent achievement, drawn from an imperfect list, the correlation would be even higher were the list of names ideally perfect.

In "Who's Who in America" the birthplaces are given in nearly every instance, although they seldom enable one to differentiate between farm or village. This difficulty can, however, be overcome by making the question one of urban as against non-urban nativity.

The leaders of to-day are about fifty years old on the average, so we must go back a half century and picture American population as it was then distributed. According to the census of 1860, there were 5,072,256 persons living in cities of over 8,000 inhabitants, out of a total population of 31,443,321, or 16.1 per cent. This standard of 8,000 or more is the one arbitrarily taken by the census bureau as constituting a city, and is so used to illustrate the growth of urban populations. There were ninety-six such cities, and a list of them is given in the "Annual Cyclopedia" for 1861. It is easy then to see if these cities have done better or worse than might be expected in producing leading men. Under initial A in "Who's Who in America," we find 128 born in cities out of 433, or 29.6 per cent. as against the 16.1 per cent. expected.

Under initial B, we find 404 out of 1,477, or 27.5 per cent.

Under initial C, we find 362 out of 1,143, or 31.7 per cent.

Under initial D, we find 213 out of 676, or 31.6 per cent.

Under initial E, we find 97 out of 273, or 35.6 per cent.

For the sake of being on the safe side I have added all the unrecorded birthplaces to the suburban and rural, and yet the latter fail to produce their proper quota in every single group, and in fact every little group of fifty or a hundred taken at random alphabetically will show the same result.

It seems unnecessary to carry investigation further to establish the fact that the urban beats the non-urban by nearly two to one. The towns, villages and farms should have produced more than five times as many leaders as the cities. They have failed to produce more than about twice as many. Thus the entire non-urban which should have given rise to about 85 per cent. of the total has only produced about 70 per cent. As a great many persons are recorded as born in towns or villages, it is evident that the number from actual farms must be considerably under Mr. Spillman's 70 per cent., at least as far as the evidence drawn from this book is concerned. The inference is that since the cities beat the non-urban districts as a whole, the towns and villages would make a proportionately better showing than the farms, were the necessary data given.

Now, as to its bearing on the question of heredity. It is an easily verified fact that talent tends to be drawn by, and to locate itself in the great centers of human activity. If we turn to the geographical index in the back part of our same biographical reference volume, we find that the great cities, New York, Chicago, Boston, etc., show two or three times as many names as would be expected merely from their populations. I think no one will question the fact that there has been a migration and selection of the most able men, especially the ambitious and gifted young

men, towards the large cities and away from the small towns and farms. This change is in process at present, and must have been going on for some time. Thus there is every reason to suppose that by the year 1860 (if not very much earlier than this) there had already taken place a part at least of this same phenomenon. So that the distribution of talent was then somewhat as it is to-day, concentrated about the cities.[1] Now if mental traits are inherited, the cities must show a higher proportionate birth of talent than the country, and our observed facts are only what we might expect.

Of course it is impossible here to separate the question of environment, which may be more favorable in the city, as some contend, or less favorable, as others sometimes think, or be the slight and almost unmeasurable force which I, myself, shall be content to hold it, until some one has succeeded in measuring it.

Mental heredity, on the other hand, has been measured, and the results are in substantial agreement.[2]

It is not the purpose of the present communication to present these figures from "Who's Who" as a proof of heredity, but only to point out that there is nothing in the distribution of the birthplaces of leading Americans to conflict with the strongest belief in the force of inheritance, should one happen to have gained such a belief from other sources.

FREDERICK ADAMS WOODS

BROOKLINE, MASS.,
February 20, 1909

[1] Conf. J. McK. Cattell, "A Statistical Study of American Men of Science," III., SCIENCE, N. S., Vol. XXIV., No. 623, December 7, 1906. A. Odin, "Genèse des grands hommes," 2 vols., 1895.

[2] Conf. F. Galton, "Natural Inheritance," London, 1889. K. Pearson, "On the Inheritance of Mental and Moral Qualities in Man, and its Comparison with the Inheritance of Physical Characters," *Biometrica*, Vol. III., 1904. E. L. Thorndike, "Measurements of Twins," *Arch. of Philosophy, Psychology and Scientific Methods*, No. 1, September, 1905. F. A. Woods, "Mental and Moral Heredity in Royalty," *Popular Science Monthly*, August, 1902, to April, 1903. Same with additions and further measurements, New York, 1906.

SCIENTIFIC BOOKS

The Principles of Mechanics for Students of Physics and Engineering. By HENRY CREW, Professor of Physics in Northwestern University. 8vo, 295 pp. New York, Longmans, Green & Company. 1908.

This book represents a course which Professor Crew has given for several years at Northwestern University to students intending to specialize in physics and in engineering. The students have had a class and laboratory college course in general physics and more or less work in elementary calculus. Professor Crew states in the preface that his purpose is "to lead the student to clear dynamical views in the shortest possible time without sacrificing him upon the altar of logic, yet pursuing a route which he can afterwards follow with safety." The plan is to confine the treatment "to that part of mechanics which is common ground for the physicist and the engineer" (again quoting the preface). The general dynamical principles involving advanced calculus and analysis are accordingly not included. There are six chapters, one on kinematics, two on kinetics, one on friction, one on elasticity and a short chapter on fluid motion. As the title of the book indicates, the principles are emphasized rather than the applications. In making such a book, every one will, of course, have his own ideas as to topics to be included and those to be omitted. Professor Crew's book represents a course of the essentials, which has been selected after actual classroom experience. An excellent feature is the attention given to rotational dynamics, a part of mechanics on which many text-books are weak. The "illustrative problems" and "examples for practise" scattered through the book are very simple, avoiding involved analyses and calculations.

While the book is intended both for students of physics and of engineering, we believe it will appeal more strongly to the student of physics and this is not so much in its subject-matter as in its temper. For the general student, the purpose of the book is admirable—namely, to take the student in the

second year of his work in physics, immediately after the completion of a course in general physics, and to give him a thorough course in the principles of mechanics stated in the language of the calculus and vector analysis, but emphasizing the physics of the subject. The statement of physical facts and concepts in mathematical language is one of the difficult steps in a student's course; and Professor Crew has done well in giving us his introductory course in the mathematical side of physics.

The book is written in a style which is always clear and interesting. The forms of statement are fresh, and the author has drawn on a wide range of reading and experience for new and apt illustrations.

A. P. Carman

The Evolution of Forces. By Gustave LeBon. Pp. 388. New York, D. Appleton & Co. 1908.

In the controversy between Mr. Norman Campbell, of Trinity College, Cambridge, and Mr. F. Legge, of the Royal Institution, concerning Dr. LeBon's writings, Mr. Campbell said:

I was a student of that author's works two years before his book appeared, and I believe that I have read every word that he has ever published on physical questions.[1]

On the basis of this thorough knowledge, Dr. Campbell places an extremely low estimate upon LeBon's work.

I have not read all of LeBon's writings by any means, but very certainly the present book on "The Evolution of Forces" is of little or no account, except in one respect only. If one wished to diagnose the ills of contemporary French science, one would find in LeBon exaggerated symptoms of a malady (not of course affecting all French scientists) which has resulted from the tremendous scientific preeminence of the French during the early part of the nineteenth century. Let one consider the state of mind of a man who can express himself after the manner of the following quotations which are taken almost at random from LeBon's book:

[1] The *Athenæum*, March 3, 1906.

This happy confidence in the great dogmas of modern science remained unaltered until the quite recent date when unforeseen discoveries condemn scientific thought to suffer doubts from which it imagined itself forever free.

There should, therefore, be no hesitation to examine closely the fundamental dogmas of science, for the sole reason that they are venerated and at first sight appear indestructible.

After I had proved that the dissociation of atoms was a universal phenomenon and that matter is an immense reservoir of energy hitherto unsuspected in spite of its colossal grandeur, etc.

Speaking of a certain matter, LeBon says:

As I expected, it was one of those classic errors repeated without verification to which repetition at length gives indisputable authority.

Speaking of another matter, he says:

All *authors* have regarded it as having a preponderating influence.

There is one idea which, according to my experience, seems to be dominant in the minds of young students, namely, that the physical science which they study in the technical school or college is *in* the text-book and was created by a *literary effort* of an *author*. Dr. LeBon, apparently, has never got beyond this childish idea. The word author, as applied to a scientist, is misleading. Our scientific men in the United States do not combine sufficiently the ability to write with the ability to search and search again, so that, although it is mildly ridiculous to call many of them authors, it would be a distinct affront to speak of them narrowly as such.

W. S. Franklin

Contribution toward a Monograph of the Laboulbeniaceae. By Roland Thaxter. Part II. With 54 plates. Memoirs of the American Academy of Arts and Sciences, Vol. XII., No. VI. 4to, pp. 219–461. Cambridge, printed by Edward W. Wheeler. June, 1908.

Nineteen years ago Dr. Thaxter published his first paper on the Laboulbeniaceae,[1] and since that time has brought out many papers in which he has steadily added much to our knowledge of the species and genera and still

[1] "On Some Species of North American Laboulbeniaceae," *Proc. Am. Acad. Arts and Sci.*, Vol. XXIV., February, 1890.

more of the structure and development of these curious entomogenous fungi. About twelve years ago he brought out "a stately quarto volume of two hundred and forty-two beautifully printed pages and twenty-six plates crowded with six hundred and seventy-two elegantly drawn figures," which the present writer reviewed in the *American Naturalist* (1897, p. 513). In this volume, which bore the same title as the one now before us, 28 genera and 158 species were recognized. And now in the second volume these numbers are increased to "more than fifty genera," and "about five hundred species and varieties." And we are told that since the completion of the plates "considerably more than one hundred additional new species have already accumulated," of which it is the author's expectation to publish figures and descriptions "with as little delay as possible."

The present publication adds to our knowledge of the structure of these plants in an instructive introductory chapter. In a brief and cautious discussion of their relationship Dr. Thaxter says:

> They are more surely Ascomycetes than many forms included in this group, and the writer sees no sufficient reason why they should not be placed in the Pyrenomycetes, as a group coordinate with Perisporiales, Hypocreales, etc.

In the systematic portion of the work the genera are arranged under two groups (orders?) viz., (I.) *Laboulbeniineae*, in which the antheridia are composed of "specially differentiated cells or groups of cells," and (II.) the *Ceratomycetineae*, in which the antheridia are composed of "more or less undifferentiated cells of the appendages or of their branches." In the first three are two families (?) viz., (1) Peyritschiellaceae (of 19 genera), with compound antheridia, and (2) Laboulbeniaceae (of 28 genera), with simple antheridia. The second order (?), which is composed of mostly aquatic plants, contains eight genera. The 44 plates are, if anything, better even than those in the previous volume, and enable one to get some idea of the structure of these very curious plants.

Dr. Thaxter asks his correspondents to communicate any additional material they may have, and it may be well to repeat here the suggestions he made in his earlier contribution in regard to the collection and preparation of Laboulbeniaceae for study (pp. 248–249).

> The collection of Laboulbeniaceae involves little more than the collection of a sufficient number of the proper hosts, although their presence on the latter is not always easy to ascertain in case of the smaller forms. In so far as concerns the collection of hosts my own experience . . . indicates that the most favorable localities in which to search for infested beetles is along the margins of small streams or of ponds. . . . Traps deposited in such situations, and made by raking together a heap of decaying grass, algae, etc., often yield large numbers of interesting specimens. Many forms may also be obtained by leaving bundles of hay or grass in cultivated ground for a few days and examining them over a sheet. Water beetles are in general best obtained by sweeping the margins of ponds or ditches with a dip-net. . . . Having obtained a number of hosts which are liable to be parasitized, it will be found that from about five to fifty per cent. will bear parasites. In order to obtain them for examination the host should be killed and impaled on a fine needle, care being taken that the surface of the insect remains perfectly clean and dry, and then examined over a dull white, and then over a black surface, with a hand lens magnifying about eight or ten diameters. . . . Every portion of the insect should be examined in different positions. . . .

Here is an opportunity for botanical collectors to exploit a new field near home, with the probability that new species or new hosts may be discovered. Any beetles on which these minute plants are found should be carefully packed, wet or dry, in clean cotton and sent to Dr. Thaxter, Cryptogamic Laboratory, Harvard University, Cambridge, Mass.

CHARLES E. BESSEY
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The Loose Leaf System of Laboratory Notes. By THEO. H. SCHEFFER, A.M. Philadelphia, P. Blakiston's Son & Company. 1908.

It fell to the lot of the present writer to review in SCIENCE of December 28, 1906, the first edition of this manual. The publishers have recently issued a "second edition, re-

vised." The revision comprises, as expressed by the author in its preface, "notes on three more types of animal life and is bound in a still more convenient form." Notwithstanding the closing statement of the author as to mode of binding, that of the former edition is continued without modification. On this point the reviewer had occasion to designate it as "the rather crude, *shoe-string* method." A more clumsy or inconvenient form of binding for such a manual could hardly be devised, and it is a pity the author's purpose of improvement might not have been realized.

Certain errors pointed out in the former review remain uncorrected in the present edition.

C. W. H.

Ergebnisse und Fortschritte der Zoologie—herausgegeben von Dr. J. W. Spengel, Professor der Zoologie in Giessen. Bd. I., Heft 1, 1907; Heft 2, 1908. Jena, Gustav Fischer.

The undertaking of Professor Spengel and a corps of collaborators to present the results and progress of zoological investigation in a series of annual volumes will meet the hearty approval of zoologists everywhere. The general plan is to issue a series of parts as they are ready, so as to make up a volume each year of between 600 and 700 pages. The parts before us at the present time contain the following contributions: (1) "Die Chromosomen als angenommene Vererbungsträger," by Dr. Valentin Häcker, 136 pages; (2) "Die verschiedenen Formen der Insectenmetamorphose, und ihre Bedeutung im Vergleich zur Metamorphose anderer Arthropoden," by Dr. Richard Heymons, 53 pages; (3) "Die Scyphomedusen," by Professor Otto Maas, 50 pages; (4) "Die Amphineuren," by Dr. H. F. Nierstrasz, 68 pages; (5) "Die gegenwärtige Stand der Kenntnisse von den Copulationsorganen der Wirbeltiere, insbesondere der Amnioten," by Dr. Ulric Gerhard, 96 pages.

If the parts are a good promise of those to follow, it is obvious that the proposed series will have an exceedingly wide scope, so that the specialist in any particular field will not find his subject represented very often. But the object is rather to enable the student to obtain authoritative information of the state of investigation in lines other than his own, and this object will certainly be admirably accomplished by such reviews with their full lists of references. The writer would raise the question whether it would not be better to classify the separate contributions so as to give each volume an individual character? The *pros* and *cons* on this question are perhaps sufficiently obvious, and it is also obvious from the list of contributions to the first two parts that the editor will not take the responsibility of giving invidious precedence to any subject.

The publication has a field of its own which is not covered by the *Zoologische Anzeiger, Zoologisches Centralblatt*, the *Concilium Bibliographicum*, the *Jahresberichte*, or by Merkel und Bonnet's *Ergebnisse der Anatomie und Entwickelungsgeschichte*. The separate contributions to the first two parts are admirably concise, sufficiently complete and critically excellent. One must admire the enterprise of our German colleagues, who find time in the midst of unremitting investigation to sum up and present to the world these necessary records of progress, which contribute to the progress itself by the mere process of organization. So long as German scientists are willing to perform such necessary functions in so admirable a way, we of a newer country and culture are relieved of such duties and should be properly grateful. American science is no longer an undiscovered bourne in Germany; on the whole, the contributions of American zoologists to the subjects treated receive adequate recognition.

Frank R. Lillie
University of Chicago

SIR WILLIAM RAMSAY ON TRANSFORMATION OF THE ELEMENTS

In the course of his presidential address before the Chemical Society, London, on March 25, Sir William Ramsay said, as reported in the London *Times*, that his subject was the hypothesis that the genuine difference between elements was due to their gain or loss of electrons. The question was whether, to take a concrete example, an atom of sodium by

losing or gaining electrons remained an atom of sodium, or whether the loss or gain of electrons did not cause it to change into some other element or elements. Having stated some theoretical arguments in favor of the possibility of transformation, he went on to describe some experiments bearing on the question. He first mentioned the transformation of radium emanation into helium, which had been amply established. He next referred to his experiments on the action of emanation on solution of copper sulphate and nitrate. Four experiments were made, and with each exactly similar duplicate experiments were tried in which no emanation was employed. A larger residue was obtained in each case from the emanation solutions than from the duplicates, and while the residues from the emanation solutions showed a faint trace of lithium, those from the duplicates failed to give spectroscopic evidence of the presence of that element. The fact of the experiments having been carried out in duplicate rendered inapplicable the criticism of Professor Hartley that accidental contamination with lithium was probable. As regards the alleged repetition of the experiments by Mme. Curie and Mlle. Gleditsch, who, using platinum vessels, obtained no greater residue and no trace of lithium, there were two possible replies—either the conditions were varied, or conceivably a trace of lithium from the glass vessel employed (which, however, had been tested for lithium with negative result) was dissolved in presence of emanation and copper but escaped solution in absence of copper or of emanation. A research on the action of emanation on solution of silver nitrate contained in a silica bulb yielded negative results, but he had stumbled across a case of apparent transformation while working in a totally different direction. On December 20, 1905, 270 grams of purified thorium nitrate were dissolved in about 300 c.c. of water, and the flask in which the solution was contained was repeatedly evacuated by a mercury pump until no gas could be pumped off. The stopcock attached to it was then closed, arrangements being made so that if any leakage occurred it would be detected. After the flask had stood for 168 days the gas in it (5.750 c.c.) was pumped out and examined for helium with doubtful results. The flask was again closed, and on August 3, 1907, after 173 days, the gas in it was again examined. Again the presence of helium was questionable, but 1.08 c.c. of carbon dioxide was found. At the next examination, on March 30, 1908, there was distinct evidence of a helium spectrum, and the gas contained 1.209 c.c. of carbon dioxide. It was then thought possible that the carbon dioxide had been produced from the grease of the stopcock, and therefore a little mercury was introduced into the capillary tube leading to the stopcock so that the latter was protected from contact with the thorium solution. After 310 days the gas was again withdrawn. Instead of 3 c.c. or 4 c.c. no less than 180 c.c. were collected; it was almost pure nitrogen, but in all 0.622 c.c. of carbon dioxide was separated from it. These experiments, Sir William Ramsay said, rendered it at least probable that thorium engendered carbon dioxide, or, in other words, that carbon was one of its degradation products. Experiments futher indicated that the action of radium emanation on thorium nitrate solutions was also attended with the formation of carbon dioxide, and the same was the case with an acid solution of zirconium nitrate. An experiment with lead chlorate proved blank, but with bismuth perchlorate the formation of carbon dioxide appeared certain. In conclusion Sir William Ramsay, after mentioning that every precaution which could be thought of was taken to exclude foreign gas, said that while these were the facts no one was better aware than he how insufficient was the proof, and that many other experiments must be made before it could be confidently asserted that certain elements, when exposed to "concentrated energy," underwent degradation into carbon.

POISONOUS EMANATIONS FROM FERRO-SILICON

Last December five Russian immigrants, the only steerage passengers on the steamer *Ashton* from Antwerp to Grimsby, were found dead on the arrival of the vessel at the latter port. Owing to bad weather the steerage ac-

commodations were tightly closed, while beneath was a cargo of ferro-silicon. The deaths were at first supposed to be from cholera, or possibly from ptomain poisoning, but these causes were subsequently excluded. The only noticeable symptoms found on post-mortem examination were connected with the lungs, which were in all cases strongly congested with dark venous blood. Cultures from the stomachs and intestines showed in several instances the presence of numerous vibrios, which so closely simulated those of cholera that they were with great difficulty distinguished from these. Suspicion was finally turned to the ferro-silicon as the cause of death and a series of experiments instituted which revealed the fact that under the influence of moisture poisonous gases are given off. Mice placed in jars over ferro-silicon soon showed symptoms of dulness and somnolency. When the ferro-silicon was moist, death preceded by disturbances of movement ensued in a few hours. Guinea-pigs under similar conditions succumbed in ten hours. The only abnormal feature on post-mortem examination was congestion of the lungs, such as is usually seen in cases of suffocation. Experiments were further instituted to determine what gases were responsible for the fatal results. Acetylene and hydrogen silicid were excluded and arsin found only in traces. Small quantities of phosphin (phosphoretted hydrogen) were found to be present, and this seems to be the principal poisonous constituent of the emanation. While little is known of the toxicology of phosphin, it is stated to be so poisonous that 0.02 per cent. of it in the air is fatal to small animals in half an hour. As ferro-silicon is formed by heating iron ore, quartz, coke and lime in an electric furnace, and as phosphorus is usually present in at least two of these constituents, phosphids, which evolve phosphin on treatment with water, would be present in ferro-silicon.

This investigation has served to throw light on several deaths which have been recorded in the past three years, which were undoubtedly due to ferro-silicon. In August, 1907, four persons died on the steamer *Olaf Wijk*, which was carrying ferro-silicon as part of its cargo. A short time before two children are recorded as dying on a Rhine steamer, having slept in a close cabin immediately over ferro-silicon, which composed a part of the cargo of the vessel. Four other cases of death on vessels carrying ferro-silicon are recorded, where the cause of death was not at the time suspected, but which are probably to be attributed to ferro-silicon.

As ferro-silicon is now used on a large scale in steel making, it is desirable that attention should be called to the fact that certain precautions should be taken in its transportation, especially that it shall be kept as dry as possible, and that it shall be well ventilated.

J. L. H.

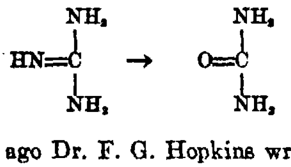
SPECIAL ARTICLES

THE PHYSIOLOGICAL SIGNIFICANCE OF CREATIN AND CREATININ[1]

Two fundamental observations have furnished the incentive to investigation and given the direction to hypotheses on the topic under discussion to-day. One of these was the discovery of *creatin* as a constant constituent of the muscular tissues of vertebrates; the other was the presence of *creatinin* in the urine of the higher animals. Creatin can be changed by the action of acids into creatinin, which in turn is supposed to form creatin in alkaline solutions. Since the chemist is able so readily to convert each of these compounds into the other in the laboratory, it was quite logical for the physiologist to assume some genetic relation between them in the living body. Creatin was looked upon as a product of protein metabolism in muscle, easily converted into its "anhydride" creatinin and thus eliminated in the urine. From this point of view two possible sources of urinary creatinin early suggested themselves, namely, an *exogenous* source in the muscle tissue (meat) consumed as food; and an *endogenous* origin,

[1] Papers read at the joint session of Section K—Physiology and Experimental Medicine—of the American Association for the Advancement of Science and the bacteriologists, biochemists and physiologists, Baltimore, December, 1908.

in the living muscles of the body itself. It was a further short step to associate muscular contraction with alterations in the creatin content of the contractile tissues; and to look for variations in creatinin output in relation to the muscular work done by the individual. In addition to this the creatin of the muscles has, because of its structural relationship, been discussed in the past as an important precursor of urea, on the assumption that the guanidin rest can be readily converted to urea in metabolism:



Ten years ago Dr. F. G. Hopkins wrote:

> The *variations* in the urinary creatinin generally follow very closely those of urea, but there can be no doubt that its quantity depends largely on the amount of creatin taken with the food.

At that time the story was as simple as it was brief. The creatin of the muscle was in some way derived from the proteins of the body; the creatinin of the urine was referable to the creatin ingested or furnished by the muscles of the body. Feeding experiments with meat and its products seemed to bear out this view and analogies lent further support.

From the outset the study of these problems was hampered by the lack of a suitable process for the estimation of these compounds. The Neubauer method, in which creatinin is isolated as a double salt with zinc chloride, was practically the only one available. Older testimony and more recent critical investigations leave no doubt that this method is utterly unreliable as a quantitative procedure for the estimation of creatinin. All of the earlier work based upon it must therefore be attended with a probability of error which has necessitated a revision of the entire subject. Here, as in so many other instances in scientific research, a good experimental method has opened up entirely new fields of observation; and to Professor Folin is due the credit for a satisfactory quantitative procedure for estimating creatin and creatinin based on Jaffé's color test with picric acid and an alkali. It has given the impetus to numerous investigations since its publication in 1904; in truth, this method, the simplicity of which makes it available in every clinic, has been responsible for a revolution in some of our ideas of metabolism. I propose to present some of these newer aspects of the physiology of creatin and creatinin, and to view them in the light of recent investigation; to inquire to what extent certain current hypotheses are justified. Bear in mind that a brief review within the limits of a symposium can neither be exhaustive nor do full justice to the newly accumulated mass of evidence; it is intended to be suggestive rather than critical—to propound problems rather than solve them.

Let us first consider the significance of creatin and creatinin in the muscle. The evidence now seems conclusive that creatinin is not present preformed in the muscular tissues (Grindley and Woods; Mellanby, '08; Mendel and Leavenworth). The fact that chemical manipulations of the extracts of muscle are quite likely to convert creatin into creatinin explains the constant occurrence of both of these compounds in commercial extracts of meat; and it warns against all conclusions regarding the physiological conversion of one compound into the other whenever appropriate conditions of analysis have not been rigorously maintained. When it is remembered that mere evaporation on a water-bath, under the acid reaction which arises post mortem, is sufficient to induce the conversion of creatin into creatinin, the liability of analytical error is emphasized. The difficulties are further increased by the fact that *quantitative* conversion of creatin into creatinin for analytical purposes is likewise attended with undeniable uncertainty (Folin, '06). These features are mentioned at the outset because they have served to complicate the experimental results to a degree where nothing short of experience seems to furnish adequate critique of the claims of investigators.

Creatin has been found in the muscles of all vertebrates which have been examined for it. From the phylogenetic point of view it is interesting, on the other hand, to note the absence of creatin from invertebrate muscle.

As we descend the scale it is still found in the lamprey, but missing in the arthropoda—the lobster and horseshoe crab, for example (Mellanby, '08; Lyman). This is only one of the chemical differences between vertebrate and invertebrate muscle and at once raises the question whether it is at all likely that creatin is functionally associated with contraction of muscle. Creatin apparently occurs in the non-striated variety of vertebrate muscle which is so frequently (and I believe without experimental justification) compared directly with the muscles of invertebrates (Saiki). Unfortunately, most of our information is still based upon the outcome of color tests rather than actual isolation experiments. Generally speaking the quantity of creatin seems to be larger in the muscles of warm-blooded animals, the hedgehog furnishing an unexplained exception in this series (Mellanby, '08).

Creatin is present in the embryonic tissues in mammals and in the developing chick, in which latter case it must be directly synthesized from the food-supply. Creatinin has not been found at any time (Mendel and Leavenworth; Mellanby, '08). In the chick the formation of creatin is apparently synchronous with, but independent of, the growth of the muscle. Mellanby has attempted to correlate the rapid increase in creatin during the later embryonic period with correspondingly rapid development of some organ, and naturally refers to the liver. He argues that since the cross-striated muscles of the invertebrates are identical with those of vertebrates —a contention which we are not inclined to admit as conclusive—and are creatin-free, muscle can not account for the phylogeny of creatin. Mellanby adds as a further biological speculation that since the "gland of the mid-gut" of invertebrates has no morphological or physiological connection with the liver of vertebrates, this newly introduced organ might account for the origin of creatin in vertebrate metabolism.

How constant is the creatin content of adult muscles; and is it altered during activity? In the light of the meager and conflicting data available to-day, a satisfactory answer can not be given to these questions. Yet they are of fundamental importance for any adequate discussion of the rôle of creatin. Mellanby's convincing experiments on isolated muscles showed that muscular work leaves creatin unaffected, as does the survival of muscle. The stability of muscle creatin is the keynote of his contentions. On the other hand, Graham-Brown and Cathcart reported an increase in the so-called total creatinin in stimulated frogs' legs when the organs were isolated, and a decrease when the circulation remained intact. Weber and Howell and Duke have observed that the vigorously beating isolated heart gives more of these compounds to the fluid perfusing it, than does the quiescent organ. In this connection it is of interest that, according to Urano, the creatin of the muscle appears to be held in some non-diffusible form in the contractile tissue and is only released when the integrity of the muscle bundles is impaired. This observation may help to explain the unique property of muscle tissue to contain such conspicuous quantities of the compound.

We must bear in mind that all experiments such as those just reported are conducted under artificial conditions different from what pertains in normal muscular activity. The isolated or perfused muscles are working both without adequate repair of the contractile substance and under impoverished nutritive conditions. A disintegration of the tissues with possible liberation of creatin under such circumstances may be an incident in this *abnormal* situation rather than a customary expression of muscular contraction; just as we know that certain features of metabolism in starvation are the evidence of extraordinary katabolic changes rather than normal sequences. At any rate, we need to know more about the actual creatin content of muscle under a variety of both normal and unusual conditions, such as rest, activity, starvation and muscular disease, before the final word can be spoken.

The study of the metabolism of creatin and creatinin has lately received a new trend through the work of Gottlieb and his collaborators (Gottlieb, Stangassinger, Rothmann). An elaborate investigation of the behavior of

these compounds in autolysis led him to postulate that they can undergo a series of enzymatic transformations in the body, as follows: (1) Creatin can be formed in the autolysis of muscles and other organs. (2) Preformed or added creatin can be converted by enzymatic means into creatinin during autolysis. (3) In the progress of autolysis both of the compounds are destroyed by appropriate enzymes, createse and creatinase. (4) The interaction of these processes affords a complicated curve for the creatin- and creatinin-content of autolyzing tissue extracts, since formation, conversion, and destruction may simultaneously go on. The behavior of creatin in the autolysis of different organs will vary according to the preponderance of one or the other of these different fermentative activities.

When we take into account the variations in the occurrence of these intracellular enzymes in the different tissues and note that the actual amount of creatin or creatinin found in an experiment at any moment represents the equilibrium point for a number of interdependent reactions the complexity of the situations becomes apparent. Truly a "bewildering array" of enzymatic processes, as Mellanby intimates in his severe critique of Gottlieb's work. Mellanby attributes the disappearance of creatin and creatinin to contaminating bacterial influences in these experiments; and he characterizes the conversion experiments as unconvincing because of the inappropriate analytical manipulations. Mellanby himself reports uniformly negative results on the behavior of creatin in autolysis. The repetition of these researches on the autolysis of tissues under more satisfactory conditions of control has, however, induced a number of investigators (van Hoogenhuyze and Verploegh, '08; Rothmann; Lefmann) to maintain the essential importance of endoenzymes in the metabolism of the compounds under discussion. Dakin has shown that arginase will not act upon creatin. The theory of the enzymatic transformation of creatin is comparable in many respects with accepted ideas regarding the metabolism of purins and other cellular products, and furnishes an attractive working hypothesis; it must, however, be admitted with reserve, if at all, until it rests upon a more substantial basis than the uncertain evidence of a color reaction.

This brings us to the facts in regard to the elimination of creatin and creatinin. The normal urine of healthy individuals contains no creatin whatever, or at most only traces. Folin's well-known observations demonstrated that the output of creatinin in an individual is practically constant despite very wide ranges of (creatinin-free) diet. This fact, now abundantly verified in many laboratories, led to the conclusion that the excreted endogenous creatinin is the expression of the true tissue katabolism, as distinguished from the exogenous protein katabolism consisting of a series of rapid hydrolytic cleavages resulting in the elimination of protein-nitrogen as urea. As might be expected, the output varies with the bulk of the metabolic tissues of the body, averaging about 15 to 20 milligrams per kilogram of body weight. The attempt to connect the excreted creatinin with tissue creatin has brought to light an apparent independence of these compounds in metabolism. Ingestion of creatinin results in increased creatinin elimination; but when creatin is fed to man or animals the creatinin content of the urine is scarcely altered, if at all (Folin, '06; Klercker; van Hoogenhuyze and Verploegh; Lefmann). Observations by Lefmann also uphold this for creatin introduced parenterally. It would appear, then, that creatin, when fed, is not converted to any extent into creatinin in the body. Furthermore, in distinction from creatinin, the creatin of the diet reappears at best only in small part as such in the urine. In the noteworthy feeding experiments of Folin the nitrogen of the creatin which disappeared was in some cases assumed not to be recovered in any form in the urine, especially where the diet was deficient in protein. Folin has advanced the tentative hypothesis that creatin may be one of those special products which serve to maintain the nitrogen equilibrium in the living tissues, but which do not easily take part in the urea-forming process; hence the muscle is found rich in creatin. When the organism is daily supplied with an abun-

dance of protein it may be preparing as much creatin as is needed for the maintenance of its normal supply. Creatin given with the food is consequently not retained by the muscles to the same extent as when the food contains an insufficient supply of protein.

Widely quoted as these experiments have been, they are scarcely conclusive on this point. Van Hoogenhuyze and Verploegh ('08) have lately maintained that the variations in the daily nitrogen output are large enough to exceed the quantities which Folin failed to recover when creatin was fed with a low diet. All feeding experiments are further complicated by the difficulty of ascertaining whether creatin is to any considerable extent destroyed by bacteria in the alimentary tract and thus escapes absorption as such. At present there is no way of telling what became of the creatin-N in the feeding experiments on record.

If, as we have learned, ingested creatin fails to increase appreciably the output of creatinin in the urine, must we not admit that the creatinin of the urine has an origin quite independent of the creatin of the muscle? "It would be most remarkable," writes Klercker, "if the endogenous creatin of the muscle were changed into creatinin in the body, whereas ingested creatin is not transformed in this way." It is, however, no more remarkable than the fact that ingested cystin may be completely oxidized in patients who are at the same time excreting the cystin which arises in their intermediary protein metabolism.

The recent investigations with the Folin method have shown that neither increased nor decreased muscular activity uncomplicated by other factors has any effect upon the excretion of creatinin (van Hoogenhuyze and Verploegh, '05; Shaffer, '08). This fact of itself can not speak against the origin of creatinin from creatin so long as it is not known what part creatin may play in the contraction of muscles. Shaffer has calculated a "creatinin-coefficient," representing the milligrams of excreted creatinin-N per kilogram of body weight, in a large number of individuals. This "coefficient" is regularly found low in individuals with lowered muscular efficiency and shows a parallelism with the muscular development and strength. He concludes that creatinin is not an index of the total endogenous protein katabolism, but is probably derived from, and an index of, some special process of the normal metabolism taking place largely, if not wholly, in the muscles. And upon the intensity of the process appears to depend the muscular efficiency of the individual. As a theory of metabolism this statement affords us little help; but as an expression of fact it elucidates a variety of interesting conditions. Thus the coefficient is found low in women, who as a rule are less developed muscularly than men; in infants with small bulk of muscular tissue; in the feeble aged; and in patients convalescent from wasting disease.

Creatin, not present in normal urines unless creatin is taken as food, is found in the urine during inanition and in certain pathological states. In starvation the creatinin output has been found to diminish gradually with the progress of the inanition. This is true likewise of another endogenous product, uric acid. The unique appearance of creatin under these circumstances must be borne in mind wherever this substance is found accompanying abnormal conditions attended by inadequate nutrition. In every such case it is reasonable to ascribe the source to the creatin of the muscles. Creatin may be excreted in acute fevers and various manifestations where there is a rapid loss of muscle proteins. Large outputs have been found in the urine of women during the first week post partum, when resolution of the uterus is taking place (Murlin; Shaffer). The fact that the creatinin elimination bears no appreciable relation to creatin in these conditions speaks further for the biological independence of the compounds.

There are numerous data already on record in attempts to connect the liver and other organs with the phases of metabolism which we are considering. It is almost too early to interpret these adequately because of the complexity of factors involved (Mellanby, '07; Spriggs, '07; van Hoogenhuyze and Verploegh, '08). In many instances, especially in the cases of hepatic disease, under-nutrition is an ever-present complication. Other cases, such as the muscular dystrophies with lowered cre-

atinin output, have a more immediate interest. Clinical investigators seem to forget that in these experiments of nature one rarely deals with simple conditions where a single organ, such as liver or muscle, is independently involved.

To attempt to formulate a theory of creatin and creatinin metabolism at this time would, in my judgment, be premature. It may, however, help us to crystallize the discussion by outlining some salient points of view. I think it will be agreed that the muscle plays a comparatively small part in the formation of creatinin. Let us assume for the moment that creatin represents a metabolism product originating in various organs, perhaps notably in the liver. It is transported about and especially deposited in the muscle in some nondiffusible combination. Most of it will be destroyed in ways that may be facilitated by enzymes. Here again it appears likely that the liver plays a prominent rôle. A part may be changed to creatinin, which may in turn be either destroyed or excreted. For this part of our hypothesis the evidence is most uncertain. Creatinin behaves as a waste product; it is decomposed with greater difficulty than is creatin, and it is eliminated more readily. But whether it represents a real end product, or like uric acid is an intermediary product, the output of which we associate with a balance between productive and destructive processes, can not yet be determined. At any rate, unchanged creatinin is promptly excreted and is nowhere to be found in detectable quantities in the organism. When the functional activities of the body are depressed or stimulated corresponding variations in creatin production and destruction may go on (van Hoogenhuyze and Verploegh, '08). So long as effective katabolic powers are maintained, the variations in creatinin output will be slight at most and in correspondence with the physiological state. Any excess of creatinin will represent only a fraction of the undestroyed increase in creatin. From this point of view the muscles would furnish creatin only as physiologically active organs and not as an incident of their contraction. The energy for contraction comes from quite different sources. When, however, the tissues are drawn upon for supplies, as in hunger or cachexia, creatin is liberated by the disintegrating muscle; and owing to the lowered effectiveness of the katabolic organ, let us say the liver, the creatin now escapes destruction and is eliminated as such. In other words, in normal metabolism creatin is continually produced and destroyed, or converted to creatinin which is speedily eliminated. In starvation preformed creatin is liberated; and neglecting to experience the customary destruction, it escapes unchanged. Here creatin is a product both of metabolism and of tissue resolution.

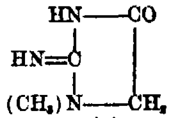
It is an easy task to offer objections to the outline just presented. A primary source of difficulty lies in the failure of most investigators to demonstrate that creatin, introduced into the circulation, in any way affects the output of creatinin. I have already spoken of this fact. Perhaps we have not yet succeeded in imitating the conditions of equilibrium which pertain in normal metabolism. Mellanby has protested against the conventional interpretation and lays primary emphasis upon creatinin, which he regards as being continually formed in the liver from substances brought to it. In the developing muscle this is changed to creatin and stored as such until a saturation point is reached, whereupon creatinin is continuously excreted. Mellanby urges that from a chemical point of view it is easier to assume the preliminary production of a cyclic structure like creatinin and its subsequent conversion to creatin, than the reverse process. Creatin is neutral and innocuous, and not likely to be changed to the strongly basic creatinin. The argument is teleological and not convincing; and to the liver are ascribed functions for which there is little evidence under either theory.

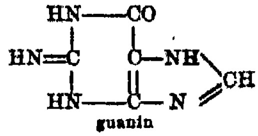
More profitable than this hypothetical discussion will be a consideration of some of the investigations which are immediately demanded. At the outset we need to know more definitely about the possible distribution of creatin in the tissues and blood; and above all, whether the creatin content of the muscle is normally a constant, as some maintain, or subjected to variations incident to activity,

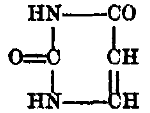
growth or atrophic changes. In view of the growing mass of data on the fate of ingested creatin and creatinin there is an unfortunate paucity of information regarding the changes which they experience after parenteral introduction into the body, where the uncertainties of change or loss in the alimentary tract are obviated and exact dosage becomes a possibility. The tendency to relegate important metabolic functions to the liver points to the desirability of studies on the fate of the nitrogenous katabolites in animals in which the hepatic functions have been excluded. In the only reference which I have found on this point, creatin was reported in noteworthy amounts in the urine of a dog after the Eck fistula operation and further extirpation of the liver (Salaskin and Zaleski).

The questions raised by the discussions regarding the intervention of enzymatic processes are timely and preeminently significant. Here, however, the limitations of the present colorimetric method are most likely to impede satisfactory progress and they invite the consideration of the analyst. The nature of the relation between inanition and excretion of creatin must be analyzed into its possibilities. Are we dealing with a general depression of katabolic organs in inanition? Or is the absence of metabolizable energy-yielding products in the tissues the sole factor? These questions are being investigated at present in our own laboratory. The behavior of the creatin bodies in the presence of microorganisms of the alimentary tract likewise deserves study, especially in view of the constant finding of methylguanidin among the products of bacterial action on creatin (Nawiasky), and of methylguanidin and dimethylguanidin in the urine (Achelis).

One can not conclude this topic without reference to the possible nitrogenous precursors of creatin and creatinin in the body. Speculation has been rife and claims have been numerous. That protein feeding does not *per se* increase the output in the urine has been conclusively demonstrated. Experiments with nucleic acid compounds (with thymus glands) which yield purin and pyrimidin derivatives structurally similar to creatinin, have had a negative outcome (Burian; Jaffé; Dorner; Lefmann).


creatinin


guanin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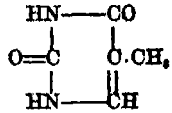
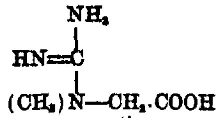
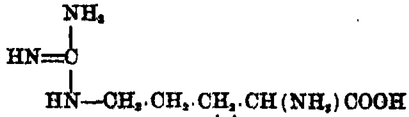
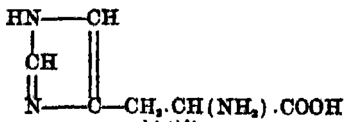

thymin

The experience with methylguanidin and with glycocyamin (guanidin acetic acid) is negative or uncertain at best (Jaffé; Dorner; Achelis). W. Koch's hypothesis relating creatinin to the metabolic change of methyl groups in the body and connecting it with the metabolism of the phosphatids (lecithin and kephalin) remains an interesting but unverified assumption. The guanidin derivate arginin stands structurally in close relation to creatin; while histidin, with its imidazole structure presents little more than analogy.


creatin


arginin


histidin

With neither of these compounds have experimental relations to creatin and creatinin been established. The nature of their synthesis still remains within the realms of surmise, inviting the organic chemist, as has so often been the case in biology, to supplement the efforts of the physiologist.

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THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION D—MECHANICAL SCIENCE AND ENGINEERING

The meetings of the section were held in the lecture rooms on the third floor of the chemical laboratory of the Johns Hopkins University. In the absence of President G. F. Swain, the vice-president of Section D, Professor Mansfield Merriman, was chosen to preside over the meetings of the section.

Professor C. A. Waldo was elected a member of the council.

Professor C. M. Woodward was elected a member of the sectional committee.

Professor Mansfield Merriman was elected a member of the general committee.

Mr. J. F. Hayford was elected vice-president for the ensuing year.

The program consisted of eight papers read by their authors, five papers read by the secretary in the absence of the authors and three papers read by title in the absence of the authors.

The vice-presidential address which was to have been given by Professor O. H. Landreth on the subject "Governmental Control of Public Waters" was omitted on account of the unavoidable and unexpected absence of Professor Landreth. The address will be published in full in a later number of SCIENCE.

Mr. B. R. Green, of the Library of Congress, Washington, D. C., in speaking on the subject "Library Book Stacks without Daylight," said in substance that daylight is extremely variable, uncertain and expensive to secure in the construction of a library book stack. At best it is injurious to the books. At least it is almost useless. Stacks must be used much at night, requiring artificial illumination. The modern electric light solves the difficulty, and, at small expense, enables the stack to be built and enclosed anywhere and be perfectly illuminated at any and every desired point within it at any time of day or night. During the discussion the writer pointed out the great economy of space which can be effected where dependence is not placed upon daylight, and cited dimensions and other data from additions to the stack space recently made in the Library of Congress.

"The Testing of Transformer Steel" was presented by Mr. M. G. Lloyd, of the Bureau of Standards, Washington, D. C. In his paper he described a new apparatus for determining the constants of transformer steel, which apparatus is a modification of the Epstein apparatus, and presented tabulated and charted results obtained with the new apparatus from ordinary steels and from the special alloy steels now being used for transformer cores.

Mr. J. H. Hayford in demonstrating that "It is not Necessary to Place Geodetic Arcs in Various Latitudes" said, in effect, that the idea seems to prevail that, in order to determine the flattening of the earth from geodetic measurements it is necessary to make the measurements in various latitudes. The basis for this idea is that the flattening must be determined by measuring radii of curvature of the spheroid which differ considerably from each other, and that arcs of the meridian in high latitudes, near the poles, have relatively long radii of curvature and those near the equator relatively short radii. But the attention should not be confined to arcs of the meridian. Since the introduction of the telegraphic method of determining longitudes, arcs of the parallel are as important as arcs of the meridian.

The flattening may be determined by measuring the difference of the radii of curvature of two arcs in any latitude, one an arc of the meridian and the other an arc of the parallel. The measurement of the latter determines the radius of curvature of the spheroid in the prime vertical plane, which, in all parts of the United States, is much longer than the radius of curvature in the meridian. The prime vertical radius is longer in latitude 49° than the meridian radius in latitude 67°. By utilizing measurements of both arcs of meridians and arcs of parallels made within the United States as great a difference of radii can be secured as from arcs of the meridian alone, scattered from latitude 26° in southern Florida to latitude 67° in northern Alaska, and three fourths as great a difference as can be secured from arcs of the meridian scattered from the equator to the poles.

These and other considerations indicate that progress is to be made in determining the flattening of the earth from geodetic measures, by securing large continuous areas of triangulation well supplied with astronomic observations, these areas to be in the most convenient localities, rather than by securing measurements of arcs of the meridian scattered through a large range in latitude.

Mr. J. Burkitt Webb, of Hoboken, N. J., discussed the subject of "House Warming." The following is an abstract of his remarks:

Direct and indirect heating, or heating by radiation and convection were compared and the former held most natural and preferable; the poisonous nature of the air of the ordinary hot-air furnace was exposed and compared with the wholesome effect of a fireplace, and hot water or steam heat discussed as a mean between the two.

The relative advantages of steam and hot water and the methods of installing these systems; the position, shape and color of radiators; the methods of generating and distributing the steam or hot water, and the method of regulation were discussed.

Professor C. N. Ricker, of Urbana, Ill., in a paper entitled "A Study of Plain Metal Base and

Bearing Plates," which was illustrated by twenty-five or thirty lantern slides, presented a summary of a bulletin soon to be issued by the Engineering Experiment Station of the University of Illinois.

The author deduced the proper theory of resistance of base plates, formulas for the safe thickness of plates of rectangular and tapered cross-sections of cast iron, and recommended the substitution and use of the straight line formula in place of the theoretical formula of very tedious application, the construction and use of a series of graphical tables for rapidly and accurately determining the dimensions and thickness of base plates employed in practical construction.

Professor A. H. Blanchard, Providence, R. I., who is assistant engineer for the State Board of Public Roads of Rhode Island, presented "An Analysis of Highway Traffic in Rhode Island."

The conclusions drawn by the writer for the roads examined are:

1. The amount of motor-car traffic which will cause disintegration is much less than is generally supposed.

2. In the case of two roads subjected to practically the same amount of motor-car traffic, the rate of disintegration will depend upon the location of the road, other conditions being equal.

3. The rate of disintegration of an ordinary macadam surface will vary almost directly as the percentage of motor-car traffic.

4. The popular belief that trap rock is the ideal road material for the surface of all macadam roads independent of the nature of the traffic to which they are subjected is a fallacy. In the case of roads subjected to horse-drawn vehicle traffic consisting of pleasure and light commercial traffic, or subjected to motor-car traffic, either exclusively or in combination with light horse-drawn vehicle traffic, the trap rock surface is exceedingly expensive to maintain. This is due to the fact that very little dust is furnished by abrasion on account of the hardness of the broken stone and hence, the binder being absent, the surface ravels under horse-drawn vehicle traffic or is disintegrated by motor-car traffic.

5. Bituminous macadam roads require a sealed surface when the highway traffic consists of a combination of heavy motor-car traffic and heavy horse-drawn vehicle traffic, while the sealed surface is not a requisite when the road is subjected to only heavy motor-car traffic. The sealed surface is considered necessary for the first class as insurance against the disintegration of the surface due to the liability of the loosening of the exposed stone by blows from the hoofs of horses and the rapid enlargement of any break in the surface by motor-car traffic.

"Recent Progress in Aeronautics," by Major G. A. Squier, U.S.A., has already appeared in SCIENCE (February 19, 1909). The lecture was very completely illustrated with lantern slides and set forth the present state of the art in a pleasing and impressive manner.

In this connection, it should be noted that the association has decided to foster this growing branch of applied science. The council will refer all papers on engineering and aeronautics to Section D, whose officers will cooperate with their authors for adequate presentation and publication.

In the paper on "State Engineering Experiment Stations," by Professor G. W. Bissell, East Lansing, Mich., the writer reviewed and compared some of the provisions of the Hale and the McKinley experiment station bills, of which the latter is now before Congress and presented the principal arguments for such a measure.

The following papers were read by the secretary in the absence of the authors:

New Methods of Back-water Computations: Professor B. F. GROAT, Minneapolis, Minn.

Variation of Pressure on the Side of a Track Spike: Professor H. S. JACOBY, Ithaca, N. Y.

Note on Specially Designed Corliss Engine for Experimental Work: Professor A. M. GREENE, Jr., Troy, N. Y.

The Specific Speed of Hydraulic Turbines: Professor L. P. MOODY, Troy, N. Y.

On the "Degree" of Railroad Curves: Professor W. G. RAYMOND, Iowa City, Iowa.

The following papers were read by title:

A Problem for State Engineering Colleges: Professor A. E. HAYNES, Minneapolis, Minn.

Temperature Stresses in Reinforced Concrete Chimneys: Professor E. R. MAURER, Madison, Wis.

A New Type of Reinforced Building Construction: Professor J. J. FLATHER, Minneapolis, Minn.

All papers were interesting and valuable and evidenced care in their preparation. The program should have been published in SCIENCE in advance. The secretary will see that this is done for the next meeting.

G. W. BISSELL,
Secretary

SOCIETIES AND ACADEMIES

THE NEBRASKA ACADEMY OF SCIENCES

THE nineteenth annual meeting of the Nebraska Academy of Sciences was held in Lincoln, Feb-

ruary 12 and 13. A larger number than usual of members out in the state were present. President A. A. Tyler delivered the president's address, on "Evidences of Evolution from the Development of Leaves."

The following papers were read before the academy:

"The Brown Chert of the Republican Valley," by E. E. Blackman.

"The Manufacture of Hog Cholera Vaccine," by A. T. Peters.

"The Season of 1908 in the Sioux County Bone Beds" (illustrated), by E. H. Barbour.

"Geometry as Pure Mathematics," by E. W. Davis.

"Paint and the Protection of Lumber," by J. Mortenson.

"Modeling Plant Structures in Paraffin," by R. J. Pool.

"A Preliminary Study in the Ethnobotany of Nebraska," by M. R. Gilmore.

"Notes on Western Indian Language," by A. E. Sheldon.

"The Scientific and Practical Value of Making Nebraska a Tuberculosis-free State," by H. W. Orr.

"A Plan for Completing the State Flora," by C. E. Bessey.

"Some Features of the Flora of Grand Island, Nebraska," by C. J. Elmore.

"The Problem of Defective Sight," by H. B. Duncanson.

"Comparison of Parasitic Fauna in Atlantic and Pacific Salmon," by H. B. Ward.

"Are Species Realities or Concepts Only?" by J. H. Powers.

"Legislative Restrictions to Animal Experimentation," by A. E. Guenther.

"The Importance of a Sanitary Milk Supply," by H. H. Waite.

"Is the Number of Chromosomes a Test in the Alternation of Generations in Plants?" by R. J. Pool.

"Notes on the Missouri Valley Loess," by S. W. Stookey.

"Measurements of Evaporation in Nebraska," by G. A. Loveland.

The session on Saturday afternoon was given over to a symposium on the "Economic Resources of Nebraska" with the following subjects and leaders:

"Trees"—Professor F. J. Phillips.

"Birds"—Professor R. H. Wolcott.

"Insects"—Professor L. Brunner.

"Forage and Fruits"—Professor C. E. Bessey.

"Minerals"—Professor G. E. Condra.

"Fish"—Professor H. B. Ward.

The academy accepted the invitation of the Nebraska Chapter of the Sigma Xi to hear the address of Professor A. G. Webster, of Clark University, on "The Creed of a Scientist," and adjourned its regular meeting on Friday evening in order to join with the botanical seminar in a Darwin anniversary meeting with the following program:

"Pre-Darwinian Evolution," by Mr. Pool.

"The Life of Darwin," by Dr. Walker.

"Darwin as a Zoologist," by Professor Ward.

"Darwin and the Geological Record," by Professor Barbour.

"Darwin's Contributions to Botany," by Professor Bessey.

"Darwin's Contributions to Plant Physiology," by Professor Wilcox.

The following were elected officers of the academy for the coming year:

President—Professor G. E. Condra, Lincoln.

Vice-president—Professor A. T. Bell, University Place.

Secretary—Professor F. D. Barker, Lincoln.

Treasurer—Professor R. J. Pool, Lincoln.

F. D. BARKER,
Secretary

THE ACADEMY OF SCIENCE OF ST. LOUIS

On Monday evening, February 15, 1909, the regular meeting of the St. Louis Academy of Science was held at the Academy Building, 3817 Olive Street. The following program had been arranged by the committee to commemorate the centenary of the birth of Charles Darwin (February 12, 1809):

"Darwin as a Naturalist," Professor S. M. Coulter.

"Darwin's Influence upon Geology," Professor W. E. McCourt.

"The Natural Selection Theory and its Later-Day Critics," Professor J. F. Abbott.

"Some Aspects of Darwin's Influence upon Modern Thought," Professor A. O. Lovejoy. (Read by Dr. Joseph Grindon.)

At the conclusion of the special program, Professor Nipher presented to the academy some changes in the manner of his experiments, and some of the additional results that he has obtained in his studies of "Momentum Effects in Electric Discharge"—reports of which have from time to time appeared in SCIENCE.

He reported that he had modified the arrangement of the wire forming the angle, in his study

of momentum effects in electrical discharge. The angle is now formed as follows: A vertical wire leads downward to the plate-holder. Its lower end terminates in a pin, the head of which is soldered to the end of the wire, and the point of the pin is just above the cover of the plate-holder. Its distance from the cover can be varied by vertical adjustment. The horizontal wire forming one side of the angle has one end soldered to the vertical wire, thus making a right angle. The distance from this junction to the pin may be varied. Satisfactory operation is obobtained when the junction is midway between the head and the point of the pin. In this way a right angle is formed with a discharge point below the vertical wire, and in line with it. Such angle-wires may be coupled with each other by joining either their horizontal or their vertical wires. The results are the same as those announced heretofore.[1] But the results are more easily obtained with this arrangement than with the one previously described.

Professor Nipher also finds that the shadow pictures obtained depend upon the material of the plate-holder. With a cover of paper or thin hard rubber, the presence of electrons is shown by branching discharge lines from the images on the film. Refraction effects are also clearly shown. When the cover is of glass or mica, with black paper, the images are like those formed by X-rays, and no refraction is shown.[2] By using a machine of large capacity and by arming a metal plate with many points directed toward a sheet of glass, shadow pictures of larger objects may be obtained.

W. E. McCOURT,
Recording Secretary

THE TORREY BOTANICAL CLUB

THE first meeting of the club for 1909 was held at the American Museum of Natural History on January 12, President Rusby in the chair.

This being the annual meeting, reports were presented by the treasurer, editor, chairman of the field committee and secretary. These were read, accepted and placed on file.

The following officers were elected for the year 1909:

President—Henry Hurd Rusby.

Vice-presidents—Edward Sandford Burgess and John Hendley Barnhart.

Secretary—Percy Wilson.

Treasurer—William Mansfield.

Editor—Marshall Avery Howe.

Associate Editors—John Hendley Barnhart, Jean Broadhurst, Philip Dowell, Alexander W. Evans, Tracy Elliot Hazen, William Alphonso Murrill, Charles Louis Pollard and Herbert Maule Richards.

THE meeting of the club was held at the Museum of the New York Botanical Garden on January 28, President Rusby in the chair.

The scientific program consisted of two papers, of which the following abstracts were prepared by the authors:

Studies in the Embryology of the Mistletoe, Dendropemon: Miss MARY M. BRACKETT.

This study was made from two species of Loranthaceæ—*Dendropemon caribæus*, gathered by Professor F. E. Lloyd from lime-trees in Dominica, and *Dendropemon parvifolius* collected by the writer from the bitter-broom, *Baccharis*, at Cinchona, in the Blue Mountains of Jamaica.

The flowers of *Dendropemon* are perfect, regular and symmetrical. The buds form in clusters of three in the axils of the leaves, and are protected by bracts. The corolla consists of six petals, which, in *D. parvifolius*, are of a reddish color on the outside, and a delicate pink within. There are six stamens borne upon an inferior ovary, the three fertile stamens alternating with three sterile stamens. The flower has one style and one stigma. At the top of the ovary is the cup-shaped calyculus.

At the time that the corolla and stamens appear as rounded knobs, two carpellary leaves meet over a central placenta, forming a cavity. The carpellary and placental tissues gradually unite, filling the cavity. Growth in the length of the pistil begins to be rapid, and the stamens develop. During this time cell-division is going on in the region of the nucellus. There is, however, nothing to mark the development of an ovule as a distinct organ, nor is there any indication of integument. In the center of the ovary the cells increase in number and size and contain large nuclei. They elongate parallel to the main axis, become irregular, and constitute the archesporial tissue. Their growth is accompanied by periclinal division in the adjacent cells. Several large archesporial cells form megaspores; the neighboring cells become disorganized and gradually disintegrate. Apparently only one of the megaspores becomes an embryo-sac.

[1] SCIENCE, July 14, 1908, and December 4, 1908.
[2] SCIENCE, February 5, 1909.

The embryo-sac was not made out in these species; but a long slit was observed reaching from the center of the ovary into the tissues of the style, which, it seemed, had been occupied by the embryo-sac. Of this Hofmeister says ("Neue Beitrage zur Kenntniss der Embryobildung der Phanerogamen," 539. 1859): "The growth in length of the embryo-sac is not ended with its formation. The sac makes its way through entangled cells of the closed style to a quarter of its length upwards."

Young stages of the proembryo were observed composed of four, and then of six cells in two parallel rows, with the long suspensor, of three greatly elongated cells, reaching into the tissues of the style for nearly half its length.

The embryo occupies a vertical position in the center of the berry, and from its position in the surrounding tissue, suggests all the characters of an orthotropous ovule. As the embryo develops, it is surrounded with endosperm. A change in the nature of the tissue below the embryo suggests a series of conducting cells between the embryo and the starch-filled cells in the lower part of the ovary. The cotyledons become green, and the suspensor gradually disappears, except for a few capping cells at the anterior end of the embryo, which now occupies the ovarial cavity for almost its entire length.

The points of particular interest are: the rapid disintegration of the cells of the gynœcium before and after fixation; the lack of an ovule as a distinct organ; the lack of integument; and the green color of the embryo as it lies in the berry.

Botanical Observations in Iceland and Spitzbergen: Miss JULIA T. EMERSON.

In July, 1908, the writer was so fortunate as to take a three-weeks' trip, touching at the following places: Kirkwall, in the Orkney Islands; Thorshavn, the chief town of the Faroes; the city of Reykjavik and village of Akreyri, in Iceland; Advent Bay and Bell Sound, in the Island of Spitzbergen; and then south to the North Cape of Norway and many places of interest on that coast.

Although all the points visited were on the coast or within reach of salt water, the flora changed according to the latitude, just as it does when one climbs a mountain, and as we went north we left behind the summer or spring vegetation which we found in Kirkwall, passed a treeless growth in Iceland, and at Spitzbergen came to an alpine flora with representatives found in the United States only on mountain summits or in the high Rockies. For instance, at Thorshavn buttercups, marigolds, forget-me-nots, daisies and other spring flowers were in bloom, and there were potatoes and gooseberries in the gardens. Our first sight of Iceland had been of great snow-fields, and we were astonished, therefore, to find any familiar plants on land. In the town were some of the plants mentioned above and two little specimens of trees, a sycamore maple and a mountain ash, very stunted, and the vegetables would not have grown without protection of the houses and good soil; on the great stony stretches which surround Reykjavik a little pink thyme, *Statice maritima*, *Silene maritima* and *S. acaulis*, *Polygonum viviparum*, *Alchemilla alpina*, several species of *Galium* and *Tofieldia palustris* were more or less abundant, and at Akreyri there was quite a luxuriant vegetation near a little waterfall outside of the settlement; pretty *Dryas octopetala*, *Eriophorum angustifolium* and *E. vaginatum*, *Parnassia palustris*, *Viola tricolor*, *Pinguicula vulgaris* and some of our ordinary weeds, also a number of mosses, especially *Grimmias*. At Spitzbergen the stones, where not covered by snow, were gay with the Iceland poppy, *Saxifraga oppositifolia*, pink or white and with a delicate odor, beautiful *Pedicularis lanata*, the pink of the flowers showing through a veil of gray hairs, *Potentilla emarginata* and *Cassiope tetragona*, making a sort of turf or bog close to the melting snow. Here we had twenty-four hours of sunshine, and the scenery was of strong contrasts, wet black or gray rocks, dazzling glaciers and dancing blue waters, where numberless birds fearlessly rested or floated about.

The contrast between these arctic conditions and the rich growth of grass, sweet yellow violets, pink campions and geraniums, etc., which we found growing in the flank of the North Cape of Norway, was very marked, but on the flat top of the cape there was only a scanty number of hardy stone-crops and other low things which could find protection between the stones from the fierce winds. The first trees seen on the southward part of the journey were birches, and they were at Lyngenfjord, still north of the arctic circle. In climbing the mountain at Digermullen we noticed the following plants, *Calluna vulgaris*, whose common name of "lyng" is said to have suggested the name of the fjord, *Cornus suecica*, violets, *Trientalis europæa*, *Vaccinium* and *Andromeda polifolia*.

[illegible] days spent at Merok and Gudvangen [illegible]ir stupendous cliffs and beautiful fjords [illegible]ing climax to an inspiring and wonderf[illegible].

[illegible] showed a photograph of a new and in[illegible]ycad collected by Dr. MacDougal and D[illegible]n Tomellin Cañon, Mexico, in 1906. The pl[illegible] sent to the New York Botanical Garden [illegible]led in the propagating houses, where it [illegible] for two years before showing any signs of [illegible]h. This appears to be a new species of [illegible].

Dr. Murrill exhibited a number of tropical fruits obtained on his recent trip to Jamaica.

[illegible] met at the American Museum of Nat[illegible]ry on February 9, at 8:15 P.M., and [illegible] to order by President Rusby.

The announced paper of the evening on "The [illegible] Forests of Mexico" was then presented by Dr. H. H. Rusby. The lecture was illustrated by lantern-slides made from protographs, many of which were obtained by the speaker while in the field. This paper has been printed in full in the January number of the *Journal of the New York Botanical Garden*, and an abstract accompanied by illustrations will appear at an early date in *Torreya*.

PERCY WILSON,
Secretary

THE AMERICAN CHEMICAL SOCIETY
NORTHEASTERN SECTION

The ninetieth regular meeting of the section was held at the Twentieth Century Club, Boston, on February 19, Dr. Arthur L. Day, director of the Carnegie Geophysical Laboratory, of Washington, D. C., addressed the section on "Some Recent Work in Geophysics." After pointing out the [illegible]ity of applying the principles of physical chemistry to the solution of many geological problems, the speaker described the electrical furnaces used in his laboratory for maintaining temperatures of about 1,500° C. He stated that the transition points for a number of one-component and two-component systems of minerals had been determined at this high temperature and that work was now in progress on a three-component system.

Professor Henry P. Talbot, of the Massachusetts Institute of Technology, presented a paper upon "Present Conceptions of the Action of the Common Indicators used in Acidimetry, and Some of their Applications." The recent advances in the knowledge of the reactions which indicators themselves undergo in changing from acid to alkaline solutions was fully reviewed and the advantages to be derived by the proper choice of indicators was clearly illustrated by experiments.

KENNETH L. MARK,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 454th meeting was held February 6, 1909, with President Palmer in the chair.

Dr. M. W. Lyon, Jr., exhibited skins and skulls of the oriental genus *Gymnura* and of the American opossum, *Didelphis*, and pointed out the close general superficial resemblances in external and cranial characteristics of these two groups of mammals from such widely separated portions of the world and members of different superorders, the Monodelphia and the Didelphia.

The chair noted the capture near Washington, on September 1, 1908, of a specimen of the little black rail, by Mr. H. M. Darling, on the eastern branch of the Potomac. For the locality this is the third actual specimen and fourth record of this the smallest of the game birds, the first record for the District of Columbia being in 1861. Though its range is from Massachusetts to the West Indies and Guatemala, the bird is seldom seen.

Dr. O. F. Cook, in a brief statement on "Mitapsis and Amitapsis," called attention to the possible importance of the recent investigations of Dr. Reginald R. Gates, of Chicago University, in the cytology of *Œnothera*. The suggestion was made that the lack of any evidence of fusion of chromatin threads at synapsis may be of more significance than the subsequent differences in the number or distribution of the chromosomes. The name *amitapsis* was proposed for the newly discovered condition in which no fusion of chromatin takes place, to contrast with *mitapsis*, the name given by Cook and Swingle to the process of chromatin fusion, considered as the final stage of the process of conjugation. Mitapsis has no necessary connection with synapsis, which is the name of the closely coiled condition of the chromatin skein. Gates finds synapsis in *Œnothera*, but no indication of mitapsis; the extremely delicate threads visible before synapsis are simple. A longitudinal splitting begins after synapsis, but is not carried out, and the new chromosomes are formed in a single chain.

If amitapsis should prove to be associated with self-fertilization it would help to explain why self-fertilized plants produce highly uniform progeny, as in vegetative propagation, whereas the progeny of normally cross-fertilized plants have notable individual diversity. Germ-cells arising through amitapsis could be viewed as vegetative products, rather than as fully sexual products of conjugation. It is easy to understand that the union of amitaptic germ-cells might merely reproduce the parental characters. Thus amitapsis may account for the uniformity of self-fertilized types, as well as for their liability to mutative derangements of characters.

The regular program consisted of the following communications:

The Blue Foxes of the Pribilof Islands: JAMES JUDGE.

The blue foxes of the Pribilof Islands are presumed to have come from the mainland of Alaska on the ice with which Bering Sea is filled during winter. The caves and subterranean passages left by the volcanic upheaval furnish the foxes with homes.

In summer the bird life furnishes an abundance of the choicest fox food. When the birds depart in the fall fox food consists of drift from the beach and the bodies of seals or sea lions which have either been killed, or died the preceding summer. This was ample until 1890, when the lessened seal and sea lion catches reduced the winter food supply and many of the animals died of starvation. The dead were eaten by the survivors, and the death rate in consequence was not noticed.

Since 1896 all seal meat not used by the natives on St. George Island has been salted and the following winter freshened and fed to the foxes. The seal meat, being insufficient in quantity, has been supplemented by dried or salt fish.

Coincident with the regular feeding begun in 1897, the old methods of trapping were abandoned. These consisted of death traps, so called, and steel traps, and a method of taking foxes from their warrens. The method of trapping now in vogue consists of capturing the animals in a large cage, in which the food intended for them is placed. Upon capture, the animals are subjected to a rigid examination and all undesirable ones are killed forthwith. Males left for breeding purposes must weigh at least 10 pounds and females at least 7½ pounds, and be either young or in the prime of life. In taking the live weights a strap is looped around the tail and the beast suspended from a spring balance attached to the ceiling of the building. The age is determined by an examination of the teeth. This is done by inserting a soft gag in the mouth and inspecting the teeth at close range. Those dismissed as breeders are branded by cutting a ring in the fur of the tail, males being branded near the end, females near the base. The men handling the foxes use heavy leather mittens.

On post-mortem examination of the animals killed in trapping the stomachs are found to carry in addition to the bait taken in the trap, grass, feathers, wild parsnip, fish bones, bird or seal bones, dirt or sand, and occasionally tunicates, sea eggs and fox fur. The intestines vary between six and ten feet in length, and were found to carry grass, feathers, wild parsnip, dirt, gravel, bones and sometimes tunicates and fox fur.

The bulk of males weighed between 8½ and 13½ pounds. That of females between 6 and 11½ pounds. Male skins when ready for market measure on an average 30 inches in length, 11 in breadth; the females are about one inch shorter and an inch narrower. The tails of both sexes are about the same length, viz., 15 inches. As a rule the fur of the female is inferior to that of the male, and among the males the best fur is found on the two- and three-year olds.

The breeding season is confined to March and the first half of April, and the young are born in litters of from five to twelve, in May and early June. Birth is given on the surface of the ground, but shortly afterwards the mother transfers the young to some place under ground, from which they do not emerge until several weeks old. While the birth rate is large, the infant mortality is very great, as only about two per female, on an average, reach maturity. They are born blind and weigh about 2½ ounces each. The eyes open on the fifteenth day, by which time the head and the tail take on a fox-like appearance. The teeth come through at or shortly after this time.

Occasionally one white fox is found in a litter of blue. Since 1897 a continuous effort has been made to exterminate white foxes, and results indicate that in time this will be accomplished, or at least that the white strain will be reduced to a minimum.

Evidence of diseases is scanty. Two cases of tuberculosis, one of uremic poisoning and thirteen cases of mange have been discovered. From the evidence at hand the males seem better able to

[illegible]limatic or other conditions than [illegible]

[illegible] thought the animals pair for [illegible] but there is only one authentic [illegible]xes jointly engaged in feeding [illegible] same litter of young. The dif[illegible] branding have shown that foxes [illegible]g together in the spring are of [illegible]here have been six cases of pro[illegible] intercourse witnessed.

[illegible]ary on St. George Island to have [illegible]breeding purposes annually. After [illegible]uota is secured all unbranded ani[illegible]to the trap are killed and their [illegible] The annual yield of skins varies [illegible]d 500.

[illegible]sland, where artificial feeding was [illegible]while a sufficient nucleus remained, [illegible]ost extinct.

*[illegible]ecombination in Second Generation [illegible]*V. J. SPILLMAN.

[illegible]ed out that Mendel discovered three [illegible]s: namely, the law of dominance, [illegible]eparation and the law of recombina[illegible] second generation.

[illegible]two laws have been adequately recog[illegible]ost breeders, but the third law, which [illegible]the most important from the standpoint [illegible]g practise, has not been sufficiently [illegible]. The law of recombination may be [illegible]: In the second generation of a hybrid [illegible] to appear every possible combination [illegible]ginal parent characters, the proportion [illegible]ulation constituted by each type being [illegible] which m is the number of characters [illegible]ence to which the type is heterozygote [illegible] total number of characters involved in [illegible]

[illegible] pointed out that in practise the applica[illegible]is law is limited:

1. [illegible]he number of individuals in the second [illegible], which must be numerous enough to [illegible]e types to occur under the operation of [illegible]of chance.
2. [illegible] hybrid must be fertile.
3. [illegible] presence of cryptomeric factors may give [illegible]ted results.
4. [illegible]n-Mendelian characters would be independ[illegible]this law.
5. [illegible]n some crosses, such as produced Burbank's [illegible]s berry, irregularities in mitosis might [illegible]teract the application of the law.

[illegible]e recent work of Professors Price and Drinkard on tomato hybrids was given as an illustration of the recombinations of original parent characters, each of the eight possible types being shown. Illustrations were given of polled Hereford cattle produced by crosses between horned Herefords and polled Durham cattle. The application of the law of recombination at the Washington State Experiment Station has resulted in the production of a winter club wheat which is now rapidly replacing the spring clubs of that section. These wheats yield considerably more than the common wheats of the section and are worth more for flour-making purposes.

The Lewis and Clark Cavern National Monument of Montana: V. K. CHESNUT.

The speaker exhibited lantern slides illustrating the features of great geologic and historic interest. The cavern which is remarkable on account of the great diversity of form, and the snow-white beauty of its drip rock, especially the helictitic forms, is a steep comparatively unexplored abyss in an isolated earth-block of Madison limestone very closely bounded on two sides by faulting planes of profound depth separating it from the Belt formation and the Three Forks shale. Including the various halls, grottoes and chambers already discovered it is about a mile in length, the largest single room being about 125 feet in diameter with supporting columns one to three feet thick running up to twenty feet in height. No excavation has been made for vertebrate fossils. The limestone itself is made up largely of blastoid stems.

Of the existing living forms the only specimen taken of unusual importance was a single phalangid spider, which has been credited recently by Professor Nathan Banks as the type of a new genus, *Cyptobunus*. The cavern, being 1,600 feet above the Jefferson River at Limespur, overlooks 75 miles or more of the Lewis and Clark route along the Jefferson and Gallatin rivers and hence it seemed appropriate that the cavern should be conserved forever a monument to the memory of these intrepid explorers. The proclamation creating it a national monument was made under the act of June 8, 1906, entitled "An Act for the Preservation of American Antiquities" and was signed by President Roosevelt on May 11, 1908.

M. C. MARSH,
Recording Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 430th regular meeting was held March 2, 1909. A preliminary presentation and explana-

tion was made by Mr. C. H. Robinson of a number of pieces of pottery, principally from Alamakee County, Iowa. Afterward the president of the society introduced Mr. Charles F. Warren, of the Bureau of Labor, who delivered a lecture of popular character on "Mexico, Its People and Customs," illustrated by colored slides. In the course of this lecture Mr. Warren touched upon the cathedrals, public buildings, gardens, markets and characteristic customs in Mexico, Cuernavaca, Puebla, Guadalajara, Guanajuato, Oajaca and other places, gave some fine views of the ruins of Mitla, and some superb examples of Mexican scenery. Finally a word was added regarding the passing of the old Mexican life and the coming of the new under President Diaz.

The 431st regular meeting of the society, March 16, 1909, was devoted to an address by Professor William H. Holmes, chief of the Bureau of American Ethnology, on "Outlines of South American Anthropology." Professor Holmes had just returned from the Pan-American scientific congress at Santiago, Chile, which he attended as special representative of the Smithsonian Institution.

He introduced his remarks by a brief sketch of the congress itself, and illustrated the journey by numerous water-color drawings. An outline of the geological development of the South American continent and the evidence of the presence of man during the Tertiary and Quaternary times were given. The tribes of the great Andean highland and their remarkable culture were described, and contrasted with the peoples and cultures of the lowlands. The wonderful progress made by the Incas, Aymaras and Chimus was illustrated by a large number of lantern slides.

Mr. W. E. Safford, of the Bureau of Agriculture, added some particulars gathered during his own sojourn in South America.

John R. Swanton,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 662d meeting was held on March 13, 1909, Vice-president Wead in the chair.

The following paper was read by invitation:

Balloon Voyages and the Use of Air Currents: Mr. H. H. Clayton, Meteorologist of the Blue Hill Observatory.

The balloon was invented about one hundred and twenty-five years ago, and at first was of scientific interest only, being early employed by the English for meteorological observations. The Germans were the next to make use of it for similar investigations.

The use of sounding balloons equipped with self-recording instruments, the methods and the results obtained with them over land and ocean areas in different regions of the globe, were discussed at some length. The results show that in the upper regions in temperate zones the trend of the air currents is easterly, while in the equatorial regions they are to the westward. In all the regions of the globe so far investigated inversion of temperature takes place at an altitude of nine miles or so; this occurs at all times of the night as well as the day, and the inversion is found to be somewhat more marked in the equatorial regions than elsewhere.

An interesting account was given of the voyage of the successful balloon in the Gordon Bennett international balloon race from St. Louis in 1904, in which the speaker was one of the invited participants. It was pointed out how the knowledge of the circulation of the upper layers of the air was utilized in making this balloon voyage of forty hours' duration to the Atlantic coast. A number of lantern slides were exhibited illustrating this voyage, and two subsequent ones which the speaker had made. It was the speaker's belief that the knowledge of air currents is destined to play an important part in the ballooning of the future.

R. L. Faris,
Secretary

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

The 181st meeting of the Elisha Mitchell Scientific Society was held in the main lecture hall of Chemistry Hall, Tuesday, 7:30 P.M., February 9, 1909.

Professor W. C. Coker described a visit to Luther Burbank in his California home, illustrating his address with lantern slides and numerous specimens of Burbank's productions.

The 182d meeting was held in the main lecture hall of Chemistry Hall, Tuesday, March [illegible], 1909, 7:30 P.M. The program was as follows:

Professor D. H. Dolley: "The Pathological Cytology of Surgical Shock: I., Preliminary Communication—The Alterations occurring in the Purkinje Cells of the Cerebellum."

Professor A. H. Patterson: "Exhibition of a Series of New Vacuum Tubes."

Alvin S. Wheeler,
Recording Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 16, 1909.

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

POST-GRADUATE STUDY IN APPLIED CHEMISTRY

THE subject assigned to me in this discussion seems to have been somewhat mixed. I have been asked to discuss:

1. To what extent is post-graduate training recognized or desired by employers of chemists?

2. What should be the attitude of technical interests toward post-graduate work?

3. What should be the attitude of technical institutions toward post-graduate study?

It matters little how the subject of our discussion is stated, it really becomes, What shall be the training or education of young men whose life work shall be the applications of chemistry, or physics, or both, in the industries? It is a question which the experience of a century at least has scarcely solved. The elements which enter into the answer are too varied, the results to be attained too manifold, the conditions available too perplexing, the personal equation too persistent. Shall the training be confined to the storage of the facts and laws of chemistry and physics in the minds and memories of the young students, trusting to the exigencies which may arise to find their application, and that when the exigencies do arise the facts and laws will be brought forth and be wisely applied? Or shall we first cause storage of facts, principles and laws, and afterwards offer training in the methods whereby these shall be applied and employed in the solution of the problems likely to arise in the industries and to demand treatment with satisfactory results?

Whatever may be said, the latter is what employers expect and demand. The questions which arise must be answered promptly and accurately. The amount of knowledge a man may have acquired and may possess is little appreciated unless it can be applied usefully and effectively. Complaint is not uncommon that young men from the technical schools are over-educated, overtrained; educated above and beyond the positions they must occupy and the work they have to do. While this is unfortunate in form of statement, it nevertheless expresses a fact. Many young men are profoundly educated in theories and laws and at the same time acquire little or no appreciation of the practical value of these theories and laws, even in the advancement of the science to which they relate, and certainly not in the solution of the problems of the industries and the arts of life. There is therefore, whether recognized or not, a demand for something beyond the regular course of study of the university or the technical school. Something beyond the mere cramming with facts and the academic training, to the exclusion of the systematic utilization of knowledge in the promotion of knowledge. Here then is the problem propounded to the educator for solution: How shall young men be educated and trained to meet the demands likely to be presented to them by the chemical industries? In the chemical industries it is natural that a profound knowledge of chemical laws should be required, but in addition to this there must be provided a sound knowledge of such laws of physics as may be necessary to the physical application of chemical laws. In the undergraduate school, first the laws of chemical action and the properties of matter, theoretical and descriptive chemistry, the methods of chemical analysis, qualitative and quantitative, must be taught, and it is well known that one of the first steps in laboratory instruction in these methods is an introduction to the forms of apparatus to be employed in the practice of experiment and analysis. Then follows the application of the laws of chemistry and of the properties of matter to the methods of operation to be used. Now since manufacturing or industrial chemistry is really analytical chemistry in a large way, similar lines of instruction and training must apply in preparation for the industries. If acquaintance with the beaker, the casserole, the filter, the evaporating dish, the distilling apparatus, must be provided in the analytical and research laboratory; if here must be taught the sources and mode of application of heat; transfer of liquids, separation of vapors, liquids and solids; so all these processes made in a small way in the laboratories must be made large in the works. Operations made in a large way must be studied, and the means for effecting them made familiar. The operation of the chemist in the laboratory must become the operation of the engineer in the works. The industries demand that the men who shall control shall have some of that capacity known as engineering, shall know something of the materials and methods of engineering, of the larger apparatus to be employed and its management, and ability to apply the laws of physics in the larger operations of the works. Chemistry and engineering must, therefore, be combined in some measure at least, in the training of the men who will become most successful in meeting the demands of the "technical interests," and whether this is recognized generally or not, it is certainly desired by employers of educated chemists.

But the common complaint of the institutions and their teachers is, that the customary four years allotted to the undergraduate course is too brief for all

that is demanded and required. Here, then, is the problem to be solved: What shall be provided in the undergraduate course or school, and shall post-graduate study and training be provided and carried on under the direction and management of the educational institution, or shall the training, which might be provided by post-graduate study, be deferred and be supplied by actual practise in the works? How, and by whom, shall this very important question be answered? The demand of the present, and of the immediate future, is for men who are able to work independently, to take care of the problems arising, and work them out to successful issue, with profitable result. Directors in the industries and employers have little time, energy or freedom from detail, to devote to the training of young men in fundamental principles. Yet experience can be had only in practise, and this must be paid for in the time, energy and material apparently wasted by young men in the earlier periods of their life work.

But the question still persists. Could the young man working under intelligent direction in the systematic application of the principles he has been taught save time? Will the work of one, two or three years under intelligent and patient training of competent teachers save time of the young man and his employers and relieve both of embarrassment, loss and disappointment?

The laudation of the German chemical industry has extended to all nations, and is probably justified. In some of the most successful branches of the German chemical industry the practise is to take into the works only men who have served as *Privatdocent* in university or technical schools, and to become *Privatdocent* the candidate must generally have taken a course in post-graduate work in investigation and in the solution of problems; work leading to the doctor's degree. First, a training for systematic applied work, then experience in teaching. The value of the latter in the preparation of young men for life work is, I believe, too little recognized. It is certainly true that one of the most excellent means of securing a thorough and fundamental knowledge of a subject is found in an effort to impart such knowledge to others.

I have said elsewhere that an important adjunct to the successful application of knowledge is a trained imagination. Not an imagination "like the baseless fabric of a vision," nor "such stuff as dreams are made on," but an imagination based upon knowledge which furnishes a vision of what may be accomplished and suggests means for accomplishment.

So it seems to me that the proper function of the undergraduate school is to communicate knowledge of facts and methods and that the function of the post-graduate school is to furnish training in the application of knowledge to the solution of problems, to the training of the imagination, and thus to meet the demands which the industries, consciously or not, are making.

A most useful beginning in such work has been made in the laboratories for research in industrial chemistry lately established in some of the leading technical institutions. Here the subjects for research, the applications of knowledge, are not of an abstract but of a concrete character, and provide training in work which may produce results immediately useful in the arts of life. Here the problems arising in the industries in every-day work are solved by students, under direction of men who have themselves been trained in the solution of such problems. By such work the imagination is stimulated and at the same time trained and directed in proper channels; habits of application es-

tablished which must be fruitful later on. The designers of these laboratories, and the authorities who have ordered their organization and establishment, as well as the industries which have patronized and encouraged them, all deserve the highest praise. It is a step in the right direction, and one which must be taken in other educational institutions, if the proper and most effective training of young men for the industries is to be secured.

What then should be the attitude of the industries to post-graduate work? I answer unhesitatingly—*favorable.* What should be the attitude of the technical institutions to post-graduate work? I answer without hesitation, *favorable.* Post-graduate work should be earnestly encouraged from both sides, from the educational and from the industrial, and particularly from the latter. It has been fully recognized in the German institutions by providing in the technical schools courses leading to the degree of "doctor of engineering," and in the universities by the establishment of similar courses and providing for the same degrees. In all educational institutions the attainment of the degree of doctor—a degree not lightly appreciated nor glibly assumed in Germany—involves work of investigation leading to results, work devoted to the application of knowledge and the solution of problems. The industries in Germany are wise in choosing for their employees and directors those who have passed through the office of *Privatdocent* and have had, therefore, experience in the training and management of men. That men may become successful without this very extended and profound training is manifest in this country, and is due largely to the men themselves. But even such men would be better equipped for their work by the training provided by the undergraduate and post-graduate schools and, though frequently compelled by their necessities to enter upon their life work without it, they would save much labor and loss of time to have had it. Many of those who, even with limited training in the schools, have been reasonably successful in the industries, and in their life work in this country, have a right to speak feelingly and affirmatively upon this point.

May young men be overtrained? Surely—in the laboratories and in the class-room, as in the gymnasium and on the athletic field; and they may be weakened, from a practical standpoint, by their training. Yet even these are often carried by their enthusiasm to eminent success. "Fools rush in where angels fear to tread," applies equally well in the world of science and industry as elsewhere, and the struggle to get out after the rush in has produced some of the best results the world has seen, though the influence and the method may not always have been recognized or acknowledged. Each one who has had experience may furnish evidence of this fact. Effort to correct error of one's own making often leads to splendid results. "Necessity is the mother of invention," and the needs of a man in deep trouble make him devise means which otherwise remain dormant and without utilization. Yet errors should be avoided, and the more thorough training should lead to this.

Will the institutions meet this demand for better trained men? Will the new courses necessary to it be established? Of this there can scarcely be a doubt. The institutions are looking for the sign and will respond to it when it is plain. But what of the industries? Will the leaders make the sign prominent and clear? Will they do their share? Do they know what their share is? And do they appreciate their responsibility?

First, the institutions must know what is needed and the knowledge can be acquired only by close relations with the industries. Teachers should have ready access to the industries and their work for themselves and their students. Problems should be submitted for the research laboratories and needed means and materials provided. Such cooperation must certainly lead to important progress, not only in the industries, but in the related sciences, and progress under such circumstances is inevitable. May the influences which control have free course, and be not only justified but glorified.

WM. MCMURTRIE

THE PROGRAM OF THE INTERNATIONAL COMMISSION ON THE TEACHING OF MATHEMATICS [1]

"IF we could first know where we are and whither we are tending, we could better judge what to do and how to do it." These words of Lincoln, like the words of many another genius, adapt themselves to divers situations. This statement epitomizes what the International Commission on the Teaching of Mathematics is to do. The first purpose of this body is to investigate the actual state of the teaching of mathematics in the various countries, and the second purpose is to discover the tendencies of the changes effected during the last two decades. Both of these investigations are to be made with a view to determining "what to do and how to do it." In the language of the central committee the aim of the commission is to suggest those general principles which should guide the teacher rather than to provide programs which should be adapted at the same time to the schools of all countries.

To Professor David Eugene Smith, of Columbia University, belongs the credit of having first suggested the formation of such a commission in the French mathematical journal, *L'Enseignement Mathematique,* in 1905 and again at the International Congress of Mathematicians at Rome in April, 1908. This congress authorized a committee consisting of Professor Felix Klein, Göttingen, Germany; Professor Sir George Greenhill, London, and Profesor H. Fehr, Geneva, Switzerland, to form an international commission. Those countries which have been represented at certainly two of the international congresses of mathematicians, with an average of at least two members, are entitled to representation on the active membership of the commission, while other countries are invited to be represented by associate members. The national delegations are urged to affiliate with themselves national subcommissions, comprising representatives of the various stages of the teaching of mathematics in the general schools and in the technical and professional schools.

General direction is lodged in the original committee of three, Klein, Greenhill and Fehr. The official organ is *L'Enseignement Mathematique,* and the official languages are English, French, German and Italian.

The whole field of mathematical instruction, from the earliest primary work to the higher mathematics of the universities, is to be included in the investigation. A large place will be given to applied mathematics for technical and professional schools.

The work of the commission will be based upon the reports of the delegations, which are to be made out with the aid of the national subcommissions in conformity with the general plan fixed by the central committee of three. In the first part of these reports will be given a view of the actual scheme of studies, the corresponding examinations, the methods of teaching and the preparation of the teaching body. In the second part will be presented the actual tendencies of the instruction.

The aim of the mathematical instruction in the different types of schools—primary, secondary, trade schools, normal schools and teachers' colleges, and colleges and universities—will be discussed. Should the aim of the instruction be the development of the mathematical faculties, or logical reasoning, or

[1] The complete Preliminary Report appeared in *L'Enseignement Mathematique*, and a translation by the author (of this article) in *School Science and Mathematics*, February, 1909.

should the ends to be attained be purely practical?

Necessarily also some large educational problems are touched which concern the whole school organization. Mention may be made of the new types of schools and of the subject of coeducation.

The committee proposes to examine anew and with care what are the branches of this science most able to contribute to general culture. What is the necessary minimum in arithmetic, algebra, geometry and trigonometry, as well as in descriptive and projective geometry, analytic geometry and the calculus? What new ideas must be introduced and what old ones should be discarded?

The much-discussed laboratory method of teaching mathematics requires close inspection. Are there not inconveniences and dangers that result? In what measure may the conventional limits which exist between certain subjects of pure mathematics be made to disappear? What have been the results of the attempts to teach algebra and geometry together? geometry and trigonometry? differential and integral calculus? Careful study needs to be made of the points of contact of mathematics with drawing, with the applied sciences, with philosophy, and with the problems of daily life.

To what extent should paper-folding, observational geometry, logarithms, graphics in algebra and the slide rule be used? Those who desire a close relation between mathematics and physics ought to show exactly what geometrical notions have a direct bearing on physics and to cite those problems of elementary physics which require simultaneous linear equations, equations of the second degree in one or more unknowns, irrational quantities and progressions.

To what degree is it possible to accord a larger place to the historical development of mathematics and to the history of the teaching of mathematics? The extensive literature on mathematical recreations might be made useful. What are the means which will give mathematics a better place in popular instruction and enable the subject to overcome popular prejudices?

The progress of teaching depends directly on the preparation of the teachers. So the committee believes that it will be useful to take account of the reforms, actual or projected, which have in view the training of teachers conformably to modern conditions. In this connection the sex of the teacher for different schools, the introduction of the teacher to scientific research, and the amount of character of the pedagogical training are questions of fundamental importance.

The high plane of this investigation is indicated by the scientific standing of the three members of the central committee as well as by the personnel of the American delegation. These men are announced by Professor Klein to be the following: Professor William F. Osgood, Harvard University; Professor David Eugene Smith, Columbia University; Professor J. W. A. Young, Chicago University.

Preliminary work is to be begun immediately; the commission as a whole to meet during the Easter recess of 1911 preliminary to making a final report to the International Congress of Mathematicians, which is to meet at Cambridge, England, in 1912.

Some may regard the work of the commission as initiating a great reform movement. Reform does not come by commission; rather this development emphasizes the great movement towards vital instruction which has been in progress for over a century. The important work of the commission will be to gather together the valuable contributions from all the world and to make them available to all the world. To select the good and discard the worthless is no small task but one well worthy of the best efforts of the leaders in mathematical thought.

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LIEUTENANT SHACKLETON'S ANTARCTIC EXPEDITION

THE Wellington, New Zealand, correspondent of the London *Times*, has cabled some details of the scientific results of the Shackleton expedition.

The frozen glacier-eroded lakes near Cape

Royds abounded in diatoms, rotifers, water bears and infusoria. Numbers of rotifers which were examined microscopically had been frozen into the ice at temperatures below zero for three years; yet after a few minutes' thawing out they suddenly revived and began eagerly devouring the fungus which abounds in these lakes. In some cases only the body, not the head, of the rotifer appeared to come to life. Several rotifers were similar to those already described by Murray as having been found at Spitzbergen and Franz Josef Land. The water bears came to life in the same manner.

On the black lava rocks of Mount Erebus which had absorbed the sun's heat the snow melted at temperatures below zero and at a height of 9,000 feet. This explains how lichens and similar plant life are enabled to flourish in the Antarctic regions.

The marine fauna near Cape Royds bears a resemblance to the types of animal life of the coal measure series found in Australia and Tasmania. Specimens will be examined by scientific specialists in New Zealand and Australia.

The northern expedition found masses of marine muds 40 feet above the sea level. These contained vast numbers of foraminiferal shells. The biloculina type, which form the biloculina ooze of the Arctic Circle, are specially abundant.

The geological discoveries disprove the Antarctic archipelago theory. The continental plateau extends from the newly discovered mountains 45 miles west of Cape Royds and the magnetic pole to beyond the south pole itself, probably over 1,800 miles. By far the most interesting geological discovery is that of coal measures in latitude 85°; these measures 1,500 feet thick, contain seams of coal 1 foot to 7 feet thick. The microscopic examination of the mineral charcoal which has been secured may indicate its geological age. Rounded quartz pebbles and the great thickness of the sandstone formation imply the action of running water prolonged through many ages. The limestone discovery at the farthest south, interstratified with a remarkable rock of pinkish gray, branded with dark green, unlike any that Professor David has ever seen, may prove important under microscopic examination. The ancient rocks examined apparently contain monazite.

Near Mount Larsen an interesting deep green mineral was found, which is almost certainly a compound of vanadium. Mount Erebus, like Stromboli, proved a good barometer, the steam column ascending and eruptions occurring with a low barometer. At periods the active crater contained molten lava. The old crater was filled almost to the brim with layers of snow. There are millions of felspar crystals 3 inches to 4 inches long, and pumice lava is of a rare kenite type. Fossil radiolaria were found in erratics of banded chert near Cape Royds. Lieutenant Shackleton is sending specimens of all these rocks to the British Museum. The exact location of the magnetic pole was fixed by elaborate triangulation by Mr. Mawson, extending over 200 miles from Mount Erebus to Mount Melbourne. It proved that the magnetic pole is no longer moving eastward as in Ross's time, but is now traveling northwestward in much the same direction as the north magnetic pole.

The summit crater of Mount Erebus was very active as regards steam and sulphur gases. No molten lava was seen, but during a big eruption in June and until September the steam column was glowing like a huge beacon fire, indicating that there was molten lava in the crater. Recently ejected "bombs" were found lying on the new snow, large quantities of sulphur being formed in the crater.

The coal measures discovered far south are probably older than the Tertiary Period; indeed, judging from the induration of the rock, they apparently date back to paleozoic times. No fossils to settle the point have been found, but a microscopic examination of the specimens may solve the problem.

THE RESIGNATION OF PRESIDENT ANGELL

THE regents of the University of Michigan have passed the following resolution:

This board has received with regret the assurance of our beloved president, Dr. James Burrill

Angell, that the time has come when, in his judgment, he should be permitted to retire from the active direction of the affairs of this university.

We desire to record here and now some measure of our appreciation of his services to this institution, of which he so long has been the head.

It is now nearly thirty-eight years since he assumed the presidency of this university. Under his leadership it has grown in student attendance from about 1,200 to more than 5,000, with a corresponding increase in faculty membership. Its advance in effectiveness of educational work and in all that goes to make a university great has been no less prominently marked. The proud position which this university has attained is due, more than to all other elements combined, to the fact that for more than one half its entire life it has been blessed with his learning, his culture, his wisdom, his tact, and, above all, with the example and inspiration of his high-minded Christian character.

It is impossible to calculate the impress for good given to the world by the 40,000 men and women who have carried with them from this institution into their work and in their lives the commanding influence of his rich character and personality.

Proud as he may justly be of the homage which the world justly yields him as educator, diplomat and publicist, he has even greater cause for pride in the grateful affection of the people of this state, whom he has served sô long and so abundantly, and in the love of the army of students, whose lives he has directly enriched and to whom he will always stand for all that is highest and best in scholarly attainments, in private character and in public and private citizenship.

The women of the University of Michigan, at their annual banquet, held at Barbour Gymnasium on April 2, passed resolutions, the first part of which read:

This occasion on which you, in your official capacity, address for the last time the body of women of the University of Michigan marks an era in the higher education of women, not alone in this commonwealth, but in America. Your assumption of Michigan's responsibilities was contemporary with our entrance into its opportunities. We were a hazardous experiment given into your hands in the face of a skeptical world. There are no adequate words to express our gratitude for your unswerving loyalty to that trust. We give you increasing homage and reverence for the gifts of genius with which you have wrought in our behalf. Yours has been, for two score years, the most potent influence in the land for the unrestricted privilege of higher education for women; yours the simplicity before which self-consciousness vanished; yours the fine courage that has helped many a sinking purpose to effective conclusion; yours the felicitous word that has parried the criticism of an over-expectant world, and has signally won where more militant methods would have lost.

SCIENTIFIC NOTES AND NEWS

The spring meeting of the council of the American Association for the Advancement of Science will be held in the Assembly Hall of the Cosmos Club, Washington, D. C., on the afternoon of Wednesday, April 21, 1909, at 4.30 o'clock.

The annual session of the National Academy of Sciences will be held in Washington, D. C., beginning Tuesday, April 20, 1909, at 11 A.M. The place of meeting will be the Smithsonian Institution. The public sessions for the presentation of scientific papers will be held in the large hall of the National Museum on Tuesday and Wednesday afternoons, April 20 and 21.

The American Philosophical Society, Philadelphia, will hold a general meeting on April 22, 23 and 24. The opening session will be held on Thursday afternoon, at 2 o'clock in the hall of the society in Independence Square. A Darwin commemoration will be held on Friday evening at 8 o'clock in the Hall of the Historical Society of Pennsylvania followed by a reception. The afternoon session on Saturday will be devoted to a symposium on earthquakes. The annual dinner of the society will be held at the Bellevue-Stratford, on Saturday evening.

Professor T. G. Bonney, F.R.S., will succeed Professor J. J. Thomson, F.R.S., as president of the British Association and will preside over the meeting to be held at Sheffield next year.

The London Geographical Society has awarded its Victoria Research medal to Mr. Alexander Agassiz. The society has awarded a special medal to Lieutenant Ernest H. Shackleton.

THE John Fritz medal for 1909 has been awarded by the committee of the national engineering societies to Mr. Charles T. Porter, of Montclair, N. J., for his work in advancing the knowledge of steam engineering and in improvements in engine construction, especially in high speed engineering. The first medal was awarded in 1903 by the board of award organized by the admirers of Mr. John Fritz, the eminent engineer, on the occasion of his eightieth birthday. The other recipients thus far have been Lord Kelvin, Thomas A. Edison, Alexander Graham Bell and George Westinghouse.

THE Mikado of Japan has bestowed on President Eliot the decoration of the Order of the Rising Sun, first class.

MANCHESTER UNIVERSITY has conferred its doctorate of laws on Professor Walter Baldwin Spencer, professor of biology in the University of Melbourne and known for his anthropological researches on the native tribes of central Australia.

PROFESSOR FERDINAND ZIRKEL, for nearly forty years professor of mineralogy and petrography at Leipzig, has retired from active service.

DR. JULIUS HANN, professor of cosmical physics at Vienna, has celebrated his seventieth birthday.

AT the meeting of the American Association of Pathologists and Bacteriologists, held last week at the Harvard Medical School, Dr. Frank D. Mallory, assistant professor of pathology of the Harvard Medical School, was elected president for the meeting to be held next year at Washington.

PROFESSOR F. D. FULLER, chief chemist, Pennsylvania Department of Agriculture, Harrisburg, Pa., has been appointed chief of the cattle food and grain investigation laboratory, Bureau of Chemistry, U. S. Department of Agriculture, Washington, D. C., and assumed the duties of his position on April 1.

UNIVERSITY COLLEGE, Oxford, has awarded the Radcliffe prize for 1909 to Mr. Arthur Frederick Hertz, Magdalen College, for his dissertation on the physiology and pathology of the movement of the intestines.

DR. HERMON C. BUMPUS, director of the American Museum of Natural History, has received letters from Dr. R. M. Anderson and Dr. V. Stefansson, explorers for the museum on the extreme north coast of Alaska. The letters were dated October 15.

Two assistant curators of the Field Museum of Natural History, Messrs. S. C. Simms and F. C. Cole, are to take up the ethnological investigation in the Philippines interrupted by the recent murder of Dr. William Jones.

THE Phi Beta Kappa address at Columbia University will be given by Dr. A. Lawrence Lowell, president-elect of Harvard University.

SENOR JOAQUIM NABUCO, ambassador from Brazil to the United States, will deliver the baccalaureate address at the University of Wisconsin.

DR. GEORGE H. PARKER, professor of zoology at Harvard University, gave a series of six lectures at the University of Illinois, March 29 to April 3, on the subjects of coral islands, the functions of the ear in fishes, and the origin of the nervous system.

THE third meeting of Research Workers in Experimental Biology, of Washington, D. C., was held at the Medical Department of George Washington University, on April 3, when Dr. Leo Loeb, assistant professor of experimental pathology in the University of Pennsylvania, read a paper on "The Experimental Production of Maternal Placenta."

SIGMA Xi Honorary Fraternity at the University of Pennsylvania initiated its new members in the Randal Morgan Laboratory on April 7. Previous to the exercises old members and new assembled in the auditorium, where Mr. H. Clyde Snook, of New York, delivered a lecture on "The Mechanical Rectification of One Million Volts."

THE Woman's College, Baltimore, in conjunction with a committee of the alumnæ association, has arranged a course of lectures on "Nutrition." The first were given last week by Dr. William J. Gies, of the College of Physicians and Surgeons of New York. Other lecturers are to be: Dr. Henry C. Sherman, New York; Dr. William H. Howell, Johns

Hopkins University; Dr. H. P. Armsby, State College, Pa., and Dr. C. W. Stiles, Washington, D. C.

The Oliver-Sharpey lectures of the Royal College of Physicians, London, have been given by Professor C. S. Sherrington, F.R.S., on "The Rôle of Reflex Inhibition in the Coordination of Muscular Action."

Professor Henry Jones, on behalf of a committee, appeals for funds towards a memorial of the late Dr. Edward Caird in the University of Glasgow—to place an inscribed tablet in the moral philosophy classroom, and to supplement the endowment of the lectureship in political philosophy.

The regents of the University of Kansas have named the entomological collections of the university the Francis Huntington Snow Entomological Collections, in honor of the late chancellor of the university.

Dr. Persifor Frazer, well known as a chemist, geologist and mining engineer as also for his studies in handwriting, died at his home in Philadelphia on April 7, at the age of sixty-three years. Dr. Frazer had been connected with the United States and Pennsylvania Geological Surveys and was at one time professor of chemistry in the University of Pennsylvania. His father was professor of natural philosophy and chemistry in the university and one of his sons is now instructor in chemistry in the institution.

Mr. Charles Aldrich, a fellow and one of the founders of the American Ornithologists' Union, died at Boone, Iowa, on March 8, at the age of eighty years. In addition to ornithology, Mr. Aldrich was interested in local history and had been curator of the State Historical Department at Des Moines, Iowa.

Dr. Arthur Gamgee, F.R.S., emeritus professor of physiology, University of Manchester, and late Fullerian professor of physiology in the Royal Institution, died in Paris on March 29, aged sixty-seven years.

Dr. van Heuvek, director of the Zoological Gardens at Antwerp, has died at the age of seventy-one years.

Dr. Ludwig Thanhoffer, professor of anatomy at Buda Pesth, has died at the age of sixty-six years.

The U. S. Civil Service Commission announces an examination on April 21, to fill three or more vacancies in the position of laboratory assistant (in chemistry) and assistant chemist in the Bureau of Standards, at salaries varying from $900 to $1,200 per annum for laboratory assistant, and from $1,400 to $1,800 per annum for assistant chemist. The duties in connection with these positions vary from routine testing to advanced work involving original investigation. As far as practicable, appointees are assigned to work in the subjects for which they are best fitted.

The *Bulletin* of the American Mathematical Society states that the Deutsche Mathematiker-Vereinigung now includes 725 members, of whom 60 are Americans. The Circolo Matematico di Palermo has a membership of 635, of whom 105 are Americans.

The annual meeting of the German Bunsen Society of Applied Physical Chemistry is to be held at Aachen on May 23–26, immediately before the International Congress of Applied Chemistry in London.

Under the will of Elizabeth F. Noble, of Mansfield, Mass., bequests of $10,000 each are made to the American Society for the Prevention of Cruelty to Animals and the American Anti-vivisection Society, $5,000 goes to the Massachusetts Society for the Prevention of Cruelty to Animals, and after other sums are paid, the three societies are to share in the residue of the estate.

The daily papers state that the Jesuit Fathers have decided to install a complete apparatus in twelve colleges belonging to their order in this country to take earthquake records.

Plans are maturing for a large exposition to be held in Buenos Ayres in May and June of 1910, on the occasion of the centennial celebration of the independence of the Argentine Republic.

All paleontologists are interested in the discoveries in the Permian of northern Russia,

and are awaiting eagerly publication of the results arrived at by Professor Amalitzky. The kinship which these remarkable animals bear to those of the Permian of North America and of South America renders the problem one of international importance. The only figures which have been published are those which appeared through the courtesy of Professor Amalitzky in a popular work by Sir Edwin Ray Lankester. All the collections have now been transferred to the Museum of the Academy of Sciences of St. Petersburg, which will be their permanent home. Professor Amalitzy is, however, the director of the Polytechnic Institute of Warsaw.

ILLUSTRATED lectures will be delivered in the lecture hall of the museum building of the New York Botanical Garden, Bronx Park, on Saturday afternoons, at four o'clock, as follows:

April 24—"A Winter in Jamaica," by Dr. William A. Murrill.

May 1—"Spring Flowers," by Dr. Nathaniel L. Britton.

May 8—"How Plants Grow," by Dr. Herbert M. Richards.

May 15—"Evergreens: How to Know and Cultivate Them," by Mr. George V. Nash.

May 22—"Collecting Seaweeds in Tropical Waters," by Dr. Marshall H. Howe.

May 29—"Vanilla and Its Substitutes," by Dr. Henry H. Rusby.

June 5—"The Selection and Care of Shade Trees," by Dr. William A. Murrill.

June 12—"The Ice Age and Its Influence on the Vegetation of the World," by Dr. Arthur Hollick.

June 19—"Haiti, the Negro Republic, as seen by a Botanist," by Mr. George V. Nash.

June 26—"Some American Botanists of Former Days," by Dr. John H. Barnhart.

July 3—"An Expedition up the Peribonca River, Canada," by Dr. Carlton C. Curtis.

July 10—"Collecting Experiences in the West Indies," by Dr. Nathaniel L. Britton.

ACCORDING to the New York *Evening Post* a valuable archeological collection has recently been installed in the museum at Vanderbilt University as the gift of General Gates P. Thruston. The relics include specimens from Tennessee, Missouri, Arkansas and other southern states and Indian relics from Peru. A number of specimens were taken from mounds near Nashville, Tenn., and show such skill as to point to some higher civilization than that of the Indians who dwelt there in historic times. The Peruvian relics show so close a resemblance to these remains that the theory of kinship between the makers of this pottery and the people of Peru has been advanced. In addition to the Indian relics, there are many minerals, gems and semiprecious stones. The collection is arranged in a room of University Hall to be known as the "General G. P. Thruston Room."

A NEW index map of Alaska, showing areas covered by topographic surveys, has been issued by the U. S. Geological Survey. On the back of this map is printed a list of the survey's publications on Alaska, arranged geographically. These publications comprise 28 maps and 119 reports. The work of the Geological Survey in Alaska, begun in 1898, has been indispensable to the development of the mineral resources of the territory. The value of the mineral output of Alaska to date is approximately $148,000,000, including the values of gold, silver, copper, coal, tin, marble and other minerals. The cost of the survey's explorations in the territory has been less than three tenths of 1 per cent. of the total value of the mineral productions. Since 1898 areas in Alaska amounting to 121,252 square miles have been topographically surveyed on a scale of four miles to the inch and 2,732 square miles on a scale of one mile to the inch. These surveys cover, respectively, 20.85 and 0.47 per cent. of the total area of Alaska, which is 586,400 square miles. During the same period geologic reconnaissance maps have been made of 99,350 square miles and detailed geologic maps of 2,304 square miles. In addition to this work, practically every mining district in Alaska has been examined, and some have been mapped in great detail. The water resources of some of the important placer districts have also been studied and the results published.

ON the invitation of President Edmund J. James, a conference was held at the University of Illinois on March 31. The conference considered the needs of the state in out-of-door improvement, both for the home and the

municipality and a state organization for this purpose was effected. The following objects and plans were considered:

1. To circulate information through publications originating with the organization and wherever procurable. These should discuss topics upon which the people want information, the kinds and uses of ornamental plants, insect enemies, the arrangement of the farm and suburban home, the practical problems of street, play ground, park and cemetery development, the customary methods of improvement organizations and kindred subjects.

2. To promote, where requested, the formation of village, municipal and neighborhood improvement and similar societies, park boards and parkway associations and to assist them within its field.

3. To advise upon the instruction of landscape gardening and ornamental horticulture, both professional and elemental in the University of Illinois and to assist in similar courses given elsewhere in the state.

4. To contribute lectures upon the subject throughout the state when requested.

5. To advise upon experiments in the hardiness and usefulness of ornamental plants in the different latitudes of the state and to encourage the creation in some form of small public plant gardens where the ornamental use of trees, shrubs and flowers can be readily studied.

6. To frame and secure necessary legislation which shall promote out-of-door art.

A collection of British birds' eggs has been presented to the Natural History Museum of Aberdeen University by Mr. R. Hay Fenton, London, a native of Aberdeen. The collection contains specimens of practically every British bird, and includes an egg of the great auk. It numbers upwards of 7,000 specimens.

The American Museum of Natural History has recently acquired, through purchase from Mr. G. R. Cassedy, of Cañon City, Colo., an iron meteorite that will form a valuable addition to the series of meteorites in the foyer of the museum. The specimen, which weighs 682 pounds, was found November 11, 1907, in Fremont County, Colorado.

Professor W. M. Davis, of Harvard University, read a paper on March 22, before the Royal Geographical Society, London, on "The Colorado Canyon." At the meeting of the society on April 5, Sir Harry Johnston gave a lecture on the scenery of Cuba, Haiti and Jamaica, with illustrations from photographs taken by him.

We learn from the London *Times* that the members of the committee of the ill-fated Danmark Arctic expedition have raised a sum of £1,250, which, if the government will provide a similar amount, will be sufficient to despatch a small motor-yacht expedition to northeastern Greenland to search for the diaries and sketches probably left at Danmark Firth by M. Mylius Erichsen, the leader of the Danmark expedition, and his companions MM. Brönlund and Hagen, who perished in an attempt to cross the inland ice in winter. The plan was set on foot by the well-known Arctic explorer Captain Ejnar Mikkelsen, who will be the leader of the new expedition, which, according to the intentions of the committee, will consist of seven persons, and will start from Copenhagen about June 15, 1909, returning in the autumn of 1910.

We learn from the London *Times* that the British Ornithologists' Union has decided to undertake a zoological exploration of the interior of Dutch New Guinea. Dr. Lorentz, who is once more on his passage out to New Guinea, has been recently up the Noord River, and mapped some of the ranges lying south of the Charles Louis Mountains, but his aims were geographical rather than zoological. The direct objective of the new expedition will be the Charles Louis Mountains, a snow-capped range forming part of the great central system stretching across the island from east to west. These are the Snow Mountains of the Dutch, and the highest peak is given on the most recent map as 17,000 feet. It is proposed that the expedition shall leave England about June, and every endeavor will be made to provide for a clear year's work. Mr. Walter Goodfellow, whose name is known from his collecting journeys in New Guinea, will be in command of the expedition, and his assistants, Mr. Stalker and Mr. Wollaston, have had some previous experience in the island. To these it is intended to add two specially-selected men, so that all branches of zoology and botany, and also of geography, may be

represented. Mr. Stalker is now on his way to the Aru Islands, where he will collect for Sir William Ingram, for whom, it will be remembered, he brought home the Prince Rudolph bird-of-paradise, which was exhibited at the Zoological Gardens last year. When his contract with Sir William is completed he will go over to the Ke Islands, and work there till the arrival of Mr. Goodfellow's party in New Guinea, when a start will be made from the south coast, just under the highest-known point of the central range. A small committee, consisting of Dr. F. D. Godman (president of the British Ornithologists' Union), Dr. P. L. Sclater (editor of the *Ibis*), Mr. E. G. B. Meade-Waldo, Mr. C. E. Fagan (treasurer) and Mr. W. R. Ogilvie-Grant (secretary), will deal with the results of the expedition. The expenses for one year's exploration have been calculated at £3,000, of which about half has been subscribed or promised.

UNIVERSITY AND EDUCATIONAL NEWS

THE legislature of Nebraska made appropriations for the State University for the biennium 1909–11 as follows: from the "one-mill university levy," for general expenses, salaries, etc., about $750,000; from the general fund—for a site for the medical college, $20,000; for experimental sub-stations (3), $45,000; for farmers' institutes, $20,000; for permanent improvements, additional land, etc., $100,000.

THE following letter has been addressed by Mr. Andrew Carnegie to the president of Hamilton College:

> In recognition of the unique services of Elihu Root as Secretary of State in the cause of international peace, through arbitration treaties negotiated by him, and in various other directions, I give the sum of $200,000 to Hamilton College, the institution of which he and his two brothers and also his two sons are graduates, and of which his father was so long a distinguished professor. In accordance with the wish of Mr. Root, this sum is to be held and invested by the trustees of the college as a trust fund, the income to be devoted to the salaries of the instructors of the college. It is to bear the name of the Elihu Root Peace Fund.

OUT of the $260,000 recently secured by Knox College ($50,000 from the General Education Board, $50,000 from Mr. Carnegie and $160,000 from the alumni and friends of the institution), $50,000 is to be used in building a Science Hall. It is expected that work will begin on this building the present season.

THE last legislature appropriated money to establish six new graduate fellowships at $500 each at the University of Kansas. They are open to teachers in Kansas colleges and to superintendents and principals of Kansas schools, who are graduates of colleges and universities of recognized standing and who have shown preeminent qualification for advanced work. A large glass company with head offices in New York City has offered $1,500 a year for two years for a fellowship for a research student working on "The optical properties of glass in relation to its chemical constitution."

MR. F. G. THOMPSON, of the class of 1897, has presented Harvard University with $50,000, for salaries in the department of history and government.

THE directors of the Krupp's Works at Essen have made an annual grant of 10,000 Marks for the aeronautic professorship at Göttingen University, to be devoted to research work connected with aeronautics.

ON recommendation of the chancellor and regents of the University of Nebraska, the legislature of the state has amended the charter of the institution so as to allow the regents to establish the following colleges, viz: (1) The Graduate College; (2) The College of Arts and Sciences; (3) The College of Agriculture; (4) The College of Engineering; (5) The Teachers College; (6) The College of Law; (7) The College of Medicine. The first named, which has hitherto been called the Graduate School, is now raised to the dignity of a college. The name of the second college has been shortened from College of Literature, Science and the Arts, to College of Arts and Sciences. The third and fourth colleges have hitherto constituted the Industrial College, and this name will now disappear, giving place to the colleges of Agriculture and of Engineering.

In the Nebraska legislature the joint resolution accepting the Carnegie pensions for the State University was defeated, although it was passed in the senate by a vote of 25 to 8. In the house it was opposed by Mr. W. J. Bryan, and was lost by a vote of 47 to 51. The matter now goes over to the next legislature.

The University of Colorado Mountain Laboratory, a department of the university's summer school, opens a six-week session on June 14, under the direction of Dr. Francis Ramaley. It is situated at Tolland, Colo., at an altitude of 8,889 feet. Courses are offered in general biology, nature study, plant ecology, anatomy and taxonomy and special lectures will be given on forestry, ornithology, physiology, climatology, glacial geology, photography and map-making.

The Rev. Dr. Marion Leroy Burton, pastor of the Church of the Pilgrims, Brooklyn, has been offered the presidency of Smith College, to succeed the Rev. Dr. L. Clarke Seelye.

At the College of Physicians and Surgeons, Columbia University, Dr. R. Burton-Opitz, adjunct professor of physiology, has, on the retirement of Professor John G. Curtis, been appointed head of the department of physiology. In the department of the practise of Medicine, Dr. Walter B. James has, at his request, been transferred from the Bard professorship, which involved the administration of the department, to a professorship of clinical medicine, and Dr. Theodore C. Janeway and Dr. Evan M. Evans, now associates in medicine, have been promoted—Dr. Janeway to the Bard professorship and Dr. Evans to a newly created professorship of clinical medicine.

Dr. George H. Ling, of the department of mathematics, Columbia University, has been advanced to the rank of adjunct professor.

At Cornell University, Professor H. H. Norris has been appointed professor of electrical engineering in charge of the department.

The professorship of physics at Lafayette College, made vacant by the death of Professor James W. Moore, M.D., has been filled by the appointment of Professor Clarence McCheyne Gordon, Ph.D., now professor of physics at Center College of Central University, at Danville, Ky.

Dr. Hermann Dürck, of Munich, has been appointed professor of pathological anatomy at Jena.

DISCUSSION AND CORRESPONDENCE

WILLIAM KEITH BROOKS

To the Editor of Science: Professor Andrews's tribute in your issue of December 4, 1908, gave the first sad intimation to western readers of the death of Dr. Wm. K. Brooks, and very acceptable information concerning his later years, much of which was news to the present writer by reason of enforced separation in work and experience. Knowing thoroughly the innate worth of the man, from intimate relations as a companion of early youth, neighbor, schoolmate and associate in early scientific work, I am minded to record a few facts which have direct bearing upon the cost to himself of Brooks's contributions to biology.

In all his training at home, in school and at college, he was rigidly surrounded with influences adverse to original research or to scientific study. His mother died before his bent had become sufficiently pronounced to arouse opposition, and it is doubtful if she would have essayed to thwart him, for she was a lady of rare qualities and keenly sympathetic with her children's dispositions. His father and his stepmother were strong adherents to the unyielding utilitarian ideas of the times, and could not then recognize the full meaning of the struggle of the youthful mind.

In 1875, near the period of culmination of the strife engendered by Darwin's work, it was no light thing to withstand the well-meant resistance of good friends who could see naught but wickedness in the new ideas. Then Brooks's character shone brightly to those who knew him best. It was, perhaps, a very little result which came from the session of the Kirtland Summer School of Natural History, in Cleveland, in that year. But it signified much more than was apparent. It was the outcome of many earnest discussions by Brooks and the writer, after some consultation

with the then aged Dr. Jared P. Kirtland. We decided to ask the Kirtland Society of Natural History to act as sponsor for our plans. Although this was conceded, and an effort was made to finance the project, it was but a gloomy outlook before the volunteer instructors when the students began to register. Albert H. Tuttle, now professor in the University of Virginia, Wm. K. Brooks and the writer, all then earning a scanty living by work not germane to the task, came before the little band of students almost empty handed. Certain influential members of the Kirtland Society had successfully prevented our use of the society's working rooms, on the ground that the smells and refuse from dissections would annoy other tenants and injure the building. The officers endeavored to raise funds, but the subscription papers headed by them were signed for such small sums that those who might otherwise have given more freely were limited by them. The money actually secured would not cover the cost of collections, to say nothing of freight and other expenses. We decided to put on a bold front, and to start with such home material as we might individually collect or purchase in local markets. But it was found impossible to rent other quarters, owing to prejudice against our "bloody" work. After anxious consultations, the plan suggested by Brooks was adopted. We would hold field sessions and depend upon enthusiasm and contact with nature to somehow work out results. As a last resort, it might be possible to utilize the barn of good old Dr. Kirtland, miles out in the country.

At this juncture there came forward keen-sighted men whose memories should be revered by all who have made sacrifices for science. Andrew J. Rickoff, then superintendent of schools of Cleveland, urged the board of education to offer free use of the Central High School Building and its appurtenances to us, as three of its former pupils, during the vacation. A resolution was passed, referring the matter to the superintendent of buildings, with power, provided that all damages accruing from dissections, etc., be made good by the summer school. There were pressures of the hand, words of encouragement and quiet exercises of influence from the great-hearted Rickoff which gave inspiration to Brooks in his splendid work of that summer. Leonard Case, owner of the building occupied by the Kirtland Society, had at first approved the use of the society rooms by the school. The adverse influences, and more particularly the objections of tenants, had caused him to rescind this privilege. He had not personally subscribed to the sustaining fund, and no one regarded him as in any way favorably inclined to our project. It was a gloomy outlook which confronted the instructors on the day before the opening, when only three teachers (from Indianapolis) had registered (Dr. David Starr Jordan was probably responsible for these). The writer, as editor of a "science column" in the Cleveland *Herald*, had published widely the plans and this appeared to be the sole outcome of months of labor and sacrifice. Mr. Benedict, proprietor of the *Herald*, and J. H. A. Bone, its talented editor, had given warm support liberally in print and by those little words which lie stored forever in memory. But to Brooks and us the apparent misunderstanding of Leonard Case was a most disheartening blow.

I can never forget the conference with Brooks in the office of the Kirtland Society, where the gross results were canvassed towards evening of that day. In words like these he spoke: "I am glad there are three of them—one apiece, all women. What could we have done—we three—if there had been but one? Three teachers, well trained, means the sowing of seed which shall yield a harvest none can measure."

We parted for the night. Left alone and heartsick, I saw Leonard Case enter the room as if he were about to do something mean. He asked "How did you come out?" "Oh, fairly," was the reply. "I don't suppose you got any too much for collections and excursions, did you?" He was told that we could manage somehow. Then he blushed and appeared ill at ease, remarking that he had regretfully kept us out of the rooms and that he had watched our work and knew with whom

he was dealing. "I don't believe you will have any trouble in finding use for a little more. Here is a trifle for you to apply, on just one condition. Put it in your pocket and expend it as you choose. Make no note of it in your accounting." He left, with a rough yellow envelope sealed in my hands. This contained seven bills of $100 each. The total contributions raised outside of this did not amount to $200, as I recall.

And the school grew. The work of Brooks was prophetic of his future career. Collections and excursions and dissections were made possible. Dr. John S. Newberry gave us two lectures on geology which were beyond and above any I ever heard for concise completeness. If from this poor little effort there came forth no other good than the launching of Brooks upon his most worthy career, it is honor indeed to have shared in the cost thereof.

THEO. B. COMSTOCK

LOS ANGELES, CAL.

SCIENTIFIC BOOKS

Histologisches Practicum der Tiere. By DR. KARL CAMILLO SCHNEIDER, A. O. Professor in the University of Vienna. With 434 text-figures. Jena, Gustav Fischer. 1908.

In view of the excellence of the first edition of K. C. Schneider's histology, which appeared about six years ago, students of the subject will welcome this new edition recently published by Fischer in Jena. The wide circulation of the first edition, together with the importance attached to it by all scientists, will enable the writer to more easily review the last edition by some slight reference to the first.

In general, it may be said that the author has endeavored, by shortening his "Lehrbuch der vergleichenden Histologie," and by slightly rearranging it, to make it more practical and to adapt it to the use of university students taking a "course" in the subject. While doing this, some of the subject-matter has been rewritten to accord with the results of recent research, and some entirely new work has been added.

The first or general part of the work opens, after the preface, with an introduction, in which the subject is defined and the view-point and method of treatment outlined. This discussion is concluded (p. 5) with two ideas which give the author's conception of histology and, of necessity, fix the form of arrangement of the whole book. The first idea is that histology should concern itself only with structure or form and should be studied and treated without regard to function. Secondly, that being a fundamental morphological study, it underlies any natural scheme of classification. The reviewer presumes that by "natural classification" is meant the classification founded upon blood relationship through evolution.

The reviewer does not wish to criticize this conception as the guiding principle in a histological course, being fully impressed with its educational value in a book so well executed as that under review. He does, however, wish to call attention to another view, held by some workers including himself, which looks upon histological structure as the important machinery through which the varied functions of organisms are performed and life is maintained. Such a view, which lays special stress on the cytological and chemical side of histology without making it altogether a study of physiology, has prompted the writing of such text-books as Prenant's "Traite D'Histologie" and Martin Heidenhain's "Plasma und Zelle." The introduction concludes with a discussion of some of the principal features of animal morphology or "Architektonik," followed by a systematic arrangement of the animal kingdom on this basis.

The remainder of the "general part" is taken up with an account of the structure of the cell, of cell division, and of the working substances of the cell; also a special account of the various groups of cells (under eleven types) and a very short account of some general principles of tissue and organ building, this latter being the last of the "general part" of the work which occupies 75 pages out of the entire 518 in the volume. When we notice that this "general part" occupied 240 pages in the former edition instead of 75, it can be seen how greatly this portion of the present edition has been reduced. This reduction has

been effected, chiefly, by cutting out about 30 pages on special organology, and 60 pages on "Architektonik" or morphology; also by omitting many figures and parts of the descriptive matter, as well as changing other parts. Some new paragraphs, mostly of a historical nature, have been inserted.

The second part of the book or "special part" deals with the descriptive histology of some 40 animal types taken in almost systematic order. The entire histology of each form is seldom discussed, but only such portions as are characteristic, or as fill out gaps in the rather rough and incomplete system of tissue classification, are described in the author's thorough and scholarly way. The whole part is divided, very arbitrarily, into 50 lessons as a convenience to teaching.

This special part is, of course, the largest and most substantial part of the book. To estimate very crudely the amount by which it has been reduced from the corresponding part in the old edition, it may be said that in the latter it occupied 685 pages, while in the new form it is contained in 445 pages. This reduction has been secured by taking out descriptions of a few entire forms and of certain of the tissues of other forms. Care has been shown in doing this, as a rule, to remove those parts which in any sense duplicated or paralleled other parts.

Comparatively little has been added to this part of the book, although it has been carefully worked over and much changed in many details. One improvement consists of the addition in several places of appropriate details of histogenesis. The omission of any allusion to the comparatively rare but important tissues that produce light and electricity is a disappointment to the reviewer; the more so that other rare tissues of possibly less fundamental importance have been left in, as a quite extensive account of the structure and development of the nettle cells of *Physophora*. All reference to gas secretion has been omitted, although it was treated of in the first edition and is a matter of scientific importance.

The index is short, too short even when one considers that the method of arrangement and table of contents both supply much that is omitted in its numbers. As an instance, a student or research man would have to search through nine pages of text to find the concise but valuable account of muscle structure in *Peripatus* (pp. 131–132), there being no indication of this item in index or table of contents. Were he to start on a comparative study of muscle he would have to search carefully in other places as well. This also holds true for other tissues.

Personally the writer would have preferred to see an enlarged edition of the former "Lehrbuch," strengthened by certain additions and revisions. One can not help feeling that the new edition is, in part, a sacrifice of scientific ideals to practical or even commercial demands. An advanced student should really have the old edition as well as the new, even if he should not prefer the first edition outright. It is to be hoped that the author will, in the near future, give to advanced students of scientific histology a third and fuller edition.

The printing, figures and general make-up are all that can be desired, and the very few errors of typography and lettering are a negligible quantity; the bibliography is full and complete. The book should be in the hands of every advanced student of histology as well as of other zoological subjects.

ULRIC DAHLGREN

Probleme der Protistenkunde. I. Die Trypanosomen ihre Bedeutung für Zoologie, Medizin und Kolonialwirtschaft. Von F. DOFLEIN, Ao. Professor der Zoologie an der Universität München. Jena, Gustav Fischer. 1909. Pp. 1–57.

Under the above title there has appeared an excellent article on the present knowledge concerning trypanosomes.

The trypanosomes are small one-celled animals bearing a flagellum on one end and an undulating membrane on the side of the body. They are classed under the protozoan group Flagellata. They are parasitic in the blood of vertebrates and cause in mammals serious diseases, such as "nagana," "surra," "dourine" in horses and "sleeping sickness" in man. The pathogenic forms are distributed

principally in South America, Asia and Africa.

Although the parasite has been known for more than half a century, very little importance was attached to it until within the last decade. As knowledge of these forms has recently advanced, so have they become very important, not only to the physician on account of their rôle in the etiology of disease, but also to the zoologist who is desirous of knowing their finer structure, their life history and their genetic affinities.

One of the important phases of the article is a discussion of the method of transmission of the parasite. Doffein points out that there are three probable modes of transmission.

The first mode is by means of cysts or spores. In such cases it would be necessary for the parasites to wander through the walls of the blood-vessels out upon the skin or mucous membrane and there form cysts. They must then be taken up with dust, water or food by an intermediate host and be carried to the vertebrate host. At present no facts are known to support this theory, except that certain authors have described stages in the blood and internal organs, which they interpreted as cysts. But these are probably nothing more than degeneration stages.

The second method is through coitus, as is the case with Spirochæta and the trypanosome causing dourine. Doflein is of the opinion that this mode of transmission may be possible in all trypanosomes, and hence regards it as an important point to be investigated.

The third method is the passive transmission through the agency of blood-sucking invertebrates. Experiments show that insects are capable of passively carrying the trypanosomes from an infected to a sound patient. Since the work of Schaudinn (1904) on the transformations of the owl trypanosome in the stomach of the mosquito, investigators have thought that the trypanosome must pass through a complicated life-cycle in an invertebrate host. Setting out with Schaudinn's work before them, they have tried to fit their discoveries to his interpretations. They have searched for male and female forms, believing that there must be a life-cycle similar to malarial forms in the mosquito. But no one has ever yet seen male and female, if they exist, in process of conjugation, and so the insect is known only to be a passive carrier of the infection.

LEROY D. SWINGLE

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The Study of Nature. By SAMUEL CHRISTIAN SCHMUCKER. Pp. 315, illustrated. Philadelphia, J. B. Lippincott and Co. 1908. $1.25.

This latest addition to the long list of books designed to guide teachers of nature study will, like many of its rivals, give much help; but still leaves the most pressing problems of elementary school nature study just where they were before its publication. This fact is mentioned not in criticism, but simply to forewarn those who eagerly expect each new book on nature study to make some decided advance towards complete establishment and successful teaching of the subject in all our elementary schools. For such a golden age of nature study we have as yet at most only a prophetic vision.

In the first chapters dealing with the principles of nature study the author follows the most advanced stage of the nature study movement when he urges as essential the observational study of natural things, as far as possible, in their natural relations and chosen for their commonness and abundance rather than for their rarity.

In the chapter on The Real Purpose of Nature Study the author agrees with many other writers in urging nature study as for many individuals a valuable addition to the general culture which is valuable for avocation rather than for the main business of life. Also be believes in practise in accurate observing and stating results as decidedly effective in establishing firm character, and in nature study as a guide to a religious attitude towards nature. All this agrees with the experience of many naturalists, but the doubting educators who have had no experience in scientific study will continue to regard these purposes as vague and not convincing. The

present uncertainties as to the place of nature study in our educational system are to no small extent due to the emphasis on such vague purposes which appeal to few who have not the naturalist's outlook to nature.

Most of the book is devoted to the practical problems of class-room management, materials and arrangement of the course of study. All these chapters are good introductions for the beginner, and especially for students in normal schools. Nine of the ten chapters on materials are devoted to animals and plants, and the tenth deals with popular astronomy. Just why the author has chosen the heavens as the only representative of the physical side of nature is not apparent to the reviewer. The signs of the times indicate that here is a weakness, and that the nature study which may win a permanent place in our elementary education of the future must have a well-balanced mixture of the biological and the physical. The physical is extremely important for interpreting the biological aspects of nature, and to most people it makes a more convincing appeal from the standpoint of every-day life.

The outline of a course in nature study is based on no apparent underlying principles, but like most other outlines published is simply a list of topics taken at random. All principles of continuity, correlation and logical development seem to be neglected. Of course there are those naturalists who urge that nature study should be free from everything resembling the formal work common to the school room; but that kind of nature study has decided limitations and has made little permanent progress in American schools.

Maurice A. Bigelow

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Columbia University

Experimental Elasticity, a Manual for the Laboratory. By G. F. C. Searle. 8vo, pp. 187. Cambridge University Press. 1908.

The character of this book can be best seen from its origin. The author has been since 1890 director of the classes in practical physics of the Cavendish Laboratory, and has prepared for his students manuscript notes giving the theory and description of the experiments. He is now collecting these notes, and after rewriting and amplifying them when needed, they are to be published in a series of volumes which will cover the usual field of practical physics. It is appropriate that the first volume should be on experimental elasticity, a subject in which Mr. Searle's contributions are well known.

The volume is divided into three chapters, the first two chapters being theoretical and the third chapter giving detailed descriptions of the methods and apparatus of fourteen experiments in elasticity. The theoretical parts are generally elementary, but the use of calculus methods is not avoided. The theorems and methods of thermodynamics are also used. The sections using these more advanced methods could, however, be easily omitted without interfering with the use of the greater part of the book. The "notes" forming an appendix to the above three chapters give discussions of some of the elementary theorems of mechanics and mensuration. From this we can infer that the more advanced sections may have been added later to make the book more complete. The longest of these "notes" is entitled Hints on Practical Work in Physics, and gives brief, pointed directions on keeping note-books, making diagrams, methods of calculations, adding also an occasional moral hint. Thus the following might well be copied and framed for use in many laboratories:

> A steady hand, a keen eye and a good command of the body are essential in accurate physical determinations; mere intellectual power avails nothing by itself. Any rule of life which deviates from temperance in all things (including work) may be expected to render the hand less steady and the eye less keen and so lead to inferior work. University students whose fingers are deeply stained with tobacco do not, as a rule, become skilful observers, though they may show considerable ability in other ways.

Laboratory courses can not in general be transplanted as a whole, since each laboratory has its own selections of apparatus and experiments—that is, if it is a live laboratory. In the case of elasticity, the variations in forms of apparatus are not great and not funda-

mental. Hence this book will be available, particularly as a reference book, in many laboratories. The discussion of elementary elastic theory is excellent and not beyond the average undergraduate. More time is evidently given to elasticity by Mr. Searle's students than is usually possible in American colleges and universities for this part of physics. The only criticism that might be made is that several of the experiments given are very complicated for a practical physics course, but these are added experiments so that none of the standard experiments have been crowded out.

A. P. Carman

SPECIAL ARTICLES

A NEW GENUS OF CARNIVORES FROM THE MIOCENE OF WESTERN NEBRASKA

While engaged in restudying the material described as *Amphicyon superbus* by the writer in the *Annals of the Carnegie Museum*, Vol. IV., p. 51, it has become apparent that the species, though allied to the European forms, should be regarded as generically distinct from them, and that it is more nearly related to *Daphænus* from the Oligocene of North America. The type specimen consists of a practically complete skeleton, which has been freed from the matrix and is ready for mounting. It is now being restudied and described in detail by the present writer.

For this new genus from the Miocene formation of western Nebraska I propose the name *Daphænodon*. The dentition and cranium show close similarity to *Daphænus* from the Oligocene, and the latter genus apparently represents the ancestral stock from which the proposed genus *Daphænodon* is descended.

Daphœnodon, gen. nov.

(Type *Daphænodon superbus* (Peterson), Specimen No. 1589, Car. Mus. Catalog Vert. Foss.)

Principal Generic Characters: Cranium comparatively short, broad, and low; muzzle large, sagittal crest prominent; brain-case small; incisors heavy and short; canines comparatively small and oval in cross-section; P^4 *with antero-internal cusp of moderately large size;* M^1 *and* M^2 *large and broad;* M^3 *present, though small, practically one-rooted and aligned with the internal border of* M^1 *and* M^2.

Upon very careful comparison of the type specimen of *Daphænodon superbus* with casts of *Amphicyon giganteus* (*A. major* Blainville) and also with illustrations of the best known European forms[1] it is evident that there are characters of considerable importance, which may be regarded as of generic value. The more important differences may be stated as follows:

The skull of *Amphicyon giganteus* is represented only by the left maxillary, but it indicates a cranium having considerably greater elevation from the alveolar border of the maxillary to the nasals than is the case in *Daphænodon superbus*. It is also seen that the alveolar border is more strongly developed posteriorly in the European genus, M^3 being succeeded by a considerable process of the maxillary, while in the American genus the border back of M^3 is extremely thin.

In the European form, *A. giganteus*, the canine is of very large size, sharply pointed, has a decided cutting edge posteriorly and a prominent rib on the antero-internal angle, which causes the cross-section of the tooth to be very elliptical, as in certain cats of the Oligocene, while the corresponding tooth in *Daphænodon superbus* is proportionally much smaller, the edges not so sharp in front and behind, and the tooth consequently having a more oval cross-section. The superior premolars in the European genus are proportionally smaller, P^4 has a distinctly smaller antero-internal tubercle and the long axis of the crown is more nearly antero-posterior, the tooth being placed less obliquely in the jaw than is the case in *Daphænodon superbus*. The superior molars of the latter genus differ in some important particulars, viz.: M^1 is of relatively greater transverse diameter and the posterior intermediate tubercles, especially the one on M^2, which closes the posterior opening of the median pit in *Amphicyon giganteus*, are absent. M^3 of the latter genus

[1] Blainville, Vol. II., Pl. XIV.; Filhol, *Ann. Soc. Geol.*, X., pp. 77–79, Pl. 10–16, 1879.

is of greater functional importance than the corresponding tooth in the American form.

From the illustrations of *Amphicyon lemanensis* by Filhol[5] it is seen that the occipital condyles of that form are less sessile, the mastoid process is of larger size, and the tympanic bullæ were probably smaller. It is also seen (Pl. XI., figs. 4, 6–8) that M^2 has three roots and the crown is occupied by three distinct cusps, a distinctly more conservative character, and properly to be considered as more primitive than that of the reduced and comparatively simple crowned M^2 of *Daphænodon superbus*. Another character which seems to indicate less specialization in the European genus is the short antero-posterior diameter of M_1, when compared with that of *Daphænodon superbus*.

It is further seen on comparison that the skull of *Daphænodon superbus* is less elongated than that of *Daphænus felinus* from the American Oligocene. The base of the skull back of the pterygoids is especially shortened. The muzzle is heavier. The incisors are larger, the antero-internal tubercle of P^4 (carnassial) is less developed, M^1 and M^2 are more developed internally, and the postero-internal angles of M_1 and M_2 are more prominent. The position of P^4 is less oblique in the alveolar border than is the case with the corresponding tooth in *Daphænus felinus*, a character tending toward conditions found in the recent dogs.

The limbs of *Daphænodon superbus* are comparatively long and slender, the thoracic region rather light, and the tail is very long. These are characteristic structural features of *Daphænus felinus* described by Mr. Hatcher in the *Memoirs of the Carnegie Museum*, Vol. I., pp. 66–95.

O. A. PETERSON

CARNEGIE MUSEUM,
March 20, 1909

[5] *L. c.*, Pl. XIII., Fig. 5.

NOTES ON MUSHROOM SPORES

IN making experiments to determine if the spores of dung-inhabiting mucors pass through the stomach and intestines of animals before they germinate, an interesting fact about the spores of mushrooms was discovered.

Some fresh horse manure, immediately after it was voided, was placed upon a sterilized plate and covered with a sterilized glass cover. On examining parts of this manure for mucor spores, there were found spores resembling mushroom spores. The plate was then set aside for three weeks when an abundant crop of mushrooms appeared. Examination proved them to be *Coprinus ephemerus* Fries.

There is a possibility that the spores might have been floating in the air and might have fallen upon the manure in the short time that it was exposed in the stable but it is not very probable that such was the case.

It seems practically demonstrated that these spores passed through the digestive tract of the horse and escaped any injurious effect from the process of digestion. They germinated and developed into mature plants in a very short time.

DAVID R. SUMSTINE

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TANKS FOR SOIL INVESTIGATION AT CORNELL UNIVERSITY

THERE are certain experiments involving fundamental problems in soil productiveness that can be conducted only where it is possible to accurately measure the conditions as they exist in the field, and to maintain the records through a great number of years. Some of these problems are as follows:

Effects of the continuous use of large amounts of mineral fertilizers upon the physical and chemical properties of the soil, and upon the bacterial flora and bacterial activity.

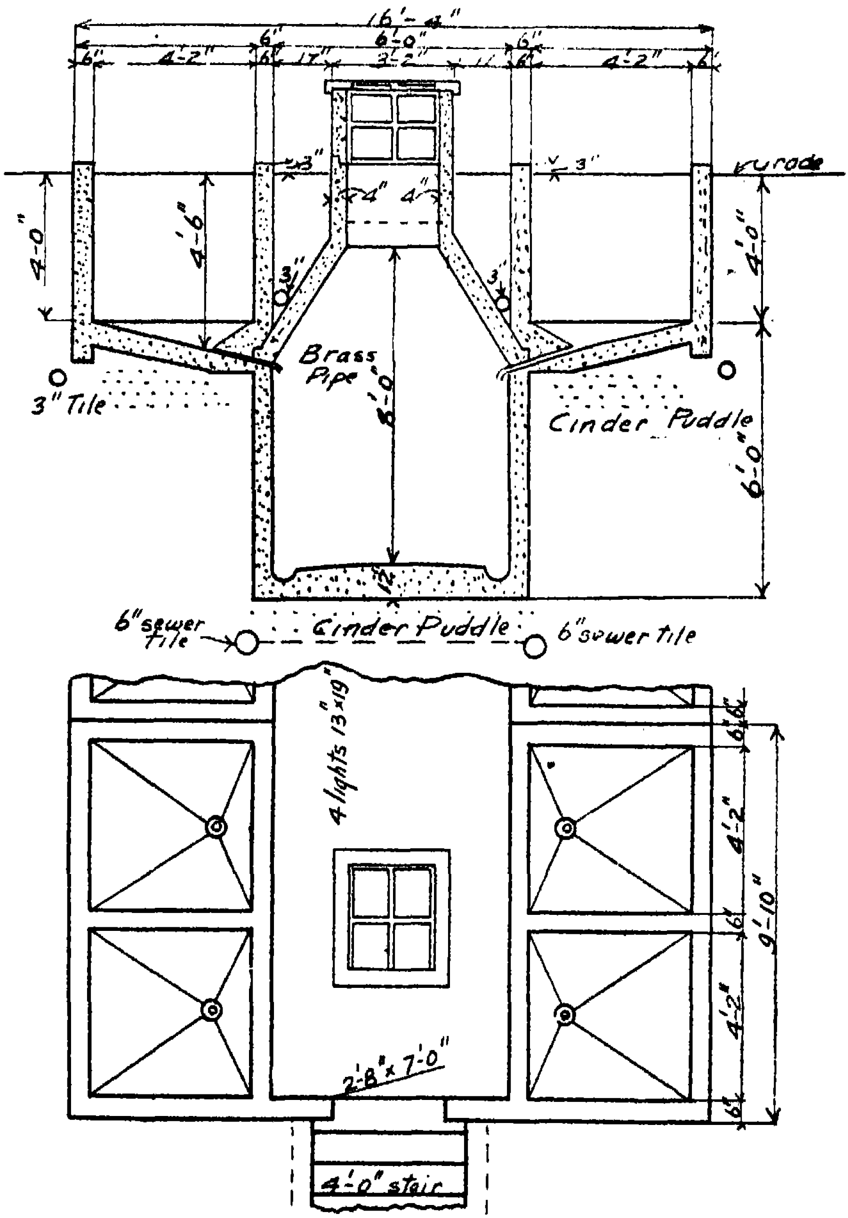
Changes that occur in a series of years when soils gradually deteriorate or improve.

Effect of different methods of soil treatment upon the loss of lime in the drainage water.

The loss of potassium and other substances occasioned by manuring with lime.

Loss of soluble salts caused by clean cultivation.

Extent to which soils under field conditions



TANKS FOR

SOIL INVESTIGATION

CORNELL UNIVERSITY

Scale 1/4" = 1'-0"

are renewed by accession of lower soil to the plowed portion.

For the purpose of conducting investigations of this kind there have been built on the farm at Cornell University a number of large tanks in which soil may be kept at the same surface level, and under conditions nearly identical with that of the surrounding soil, upon which duplicate tests are made. They are intended to furnish receptacles for bodies of soil of sufficient size to produce plants in a normal manner under approximately field conditions, and yet afford opportunity for measuring a large number of the factors affecting plant growth. The construction is of concrete, but the tanks will be lined.

Each tank is four feet two inches square with a maximum vertical depth of four feet six inches and a minimum depth of four feet. There are twenty-four tanks placed in two rows of twelve tanks each. Between the rows of tanks is a tunnel, the bottom of which is ten feet below the top of the tanks. The tunnel is six feet wide. From the lowest point in each tank is an outlet tube two inches in diameter and tin lined. It is made large enough to permit of easy cleaning and has no bends in it. A piston runs through the tube to within four inches of the upper end. Between the perforated head of the piston and the soil, glass wool is to be inserted. The piston can be withdrawn if it is desired to clean the tube.

Drainage water from each tank will be caught in a receptacle in the tunnel. The lining in the tanks will prevent any soluble material in the concrete from appearing in the drainage water. A constant water table at any desired depth may be maintained by raising the rubber tube leading from the outlet tube to a corresponding point below the surface of the soil in the tank.

The tanks, as described, will each contain between three and four tons of soil, and the surface will constitute approximately .0004 of an acre. They are built with special reference to durability so that it will be possible to plan for experiments to extend over a long period. The quantity of soil contained is not too large to allow of accuracy in sampling and yet is sufficiently large to closely resemble field conditions, which is not true of the quantity contained in pots. No covering is to be placed over the tanks, but in every way natural conditions are to be permitted. The top soil and subsoil will be placed in their relative positions. It is expected that the rainfall will be sufficient to meet the needs of the crops, but if the plants suffer during periods of drought they can be watered artificially.

Any desired type of soil may be used which is not possible with ordinary field experiments. It is also possible to make a comparison of different soil types under any desired condition which may be very serviceable in ascertaining the effect of those properties differentiating these types upon certain factors in soil productiveness.

The chief feature of the plan is that of keeping accurate records of the factors affecting plant growth without producing artificial conditions.

The tube leading from the bottom of the tank is designed to carry off the drainage water into a receptacle which will permit the quantity to be measured and its constituents to be determined.

The accompanying diagram shows the plan and cross-section of these tanks.

T. L. LYON

THE GEOLOGICAL SOCIETY OF AMERICA

THE twenty-first annual meeting of the Geological Society of America was held under the presidency of Professor Samuel Calvin, of Iowa City, Iowa, in the rooms of the geological department, Johns Hopkins University, Baltimore, Tuesday, Wednesday and Thursday, December 29, 30 and 31, 1908.

The first session of the meeting was called to order at ten o'clock Tuesday morning with President Calvin in the chair and the society was cordially welcomed to Baltimore by Professor W. B. Clark in a few well-chosen remarks, to which appropriate response was made by President Calvin.

The secretary, Dr. E. O. Hovey, of the American Museum of Natural History, reported that the printed list of fellows contained 294 names, the

same as at the time of making the last annual report. During the year the four new fellows elected at the Albuquerque meeting qualified; two fellows, Homer T. Fuller and William S. Yeates, were lost by death, and two by resignation. After presentation of the memorials of the deceased fellows the regular program of papers was taken up as follows:

The first paper read was:

Some Distinctions between Marine and Terrestrial Conglomerates: JOSEPH BARRELL, New Haven, Conn.

The problem was approached by studying the effects of shore, as compared with subaerial, activities upon the production, transportation and deposition of gravel. It has been found that the truly terrestrial forces produce vastly more gravel, spread it far more widely, and provide more opportunities for deposition, than do the forces of the littoral zone. Conglomerate formations, therefore, should be dominantly of terrestrial origin. In order to determine, however, the mode of origin of particular examples, definite criteria must be drawn between the two classes. It was shown that the thickness was one of the most important of these marine conglomerates, except under local and special circumstances, being limited to considerably less than one hundred feet in thickness, terrestrial conglomerates, on the other hand, being frequently measured in hundreds and occasionally in thousands of feet.

Attention was next turned to the significance of the intercalated non-conglomeratic beds and the relations to the under- and over-lying formations, with the conclusion that the characteristics of the associated strata are frequently of high supplemental value for determining the mode of origin.

Applications of the conclusions were made to several conglomeratic formations.

Professor Barrell's paper was discussed by Messrs. G. K. Gilbert, J. Barrell and W. H. Hobbs.

The following papers were read by title:

The Chemistry of the Pre-Cambrian Rivers: REGINALD A. DALY, Boston, Mass.

The Primary Origin of the Foliated Structure of the Laurentian Gneisses: FRANK D. ADAMS and ALFRED E. BARLOW, Montreal, Canada.

Relations of Present Profiles and Geologic Structure in the Desert Ranges: CHARLES R. KEYES, Des Moines, Iowa.

Deflation and the Relative Efficiencies of Erosive Processes under Conditions of Aridity: CHARLES R. KEYES, Des Moines, Iowa.

Then were read:

Unconformity Separating the Coal-bearing Rocks in the Raton Field, New Mexico: WILLIS THOMAS LEE, Washington, D. C.

The coal-bearing rocks of northern New Mexico in the vicinity of Raton occupy the southern part of the Raton Mountain region. The rock formations are the same as those of the Trinidad coal field in southern Colorado, heretofore referred to the Laramie. Recent work in the Raton field has proved that there are two coal-bearing formations separated in time by a period of erosion. The evidence of the hiatus is found: (1) in the partial removal of the older beds, (2) in the character of the pebbles found at the base of the younger formation, (3) in the affinities of the fossil plants.

Evidence that the Appalachian and Central Coal Fields were once connected across Central Kentucky: ARTHUR MILLER, Lexington, Ky.

In support of the view long entertained, that the different Carboniferous coal fields of the United States were formerly connected, the writer during the past summer found deposits of Coal Measure conglomerate in a narrow band along the watershed between the Green and Salt rivers, and in previous years had noted it between Bacon Creek, a tributary of Nolin River, and Green River; and also on the top of King's Mountain, near the head of Green River. During most of this stretch it forms the crest of Muldrow's Hill. It consists of massive bowlders of large quartz pebble conglomerate and great banks of pebble and sand waste. It has contributed much material to the lands lying south of Muldrow's Hill, giving to many of them a sandy character. It itself, near the middle of its course, is deeply dissected, resembling in its topography, soils and population, the same formation in eastern Kentucky.

The Bearing of the Tertiary Mountain Belt upon the Origin of the Earth's Plan: FRANK BURSLEY TAYLOR, Fort Wayne, Ind.

Suess showed with great clearness and force that the peripheral mountain system of Asia was formed by horizontal thrust movements from the north; *i. e.*, from the interior of the continent towards the ocean.

In the present paper the following points are dwelt upon as tending to confirm Suess's generalization and the writer's extension thereof:

1. The Tertiary mountain arcs and island festoons of Asia bulge outward towards the south, showing southward crustal creep of the continental mass.

2. The Himalaya mountain range exceeds others in height, because it was so severely pressed against the north side of the older plateau of

India. The Malay arc, lapping around the eastern end of the Himalaya and swinging far to the south—even beyond the equator—met no such obstacle. It spent itself more freely and formed the most remarkable of the great earth-lobes of Asia.

3. At its eastern end the tectonic line of the Aleutian island arc penetrates to the heart of the mountain knot of Alaska, so that westward from about the 148th meridian, west longitude, Alaska belongs structurally to Asia.

4. The Tuscarora deep, close in front of the Japan and Kurile Island arcs, and also the long, narrow deep, close in front of the Aleutian arc, mark areas probably in part elastically depressed by the weight of the adjacent more or less overthrust masses. They mark the negative side of these great tectonic lines, while the high, though largely submerged, mountain ranges of the adjacent island arcs mark the positive, uplifted side of the same lines. These troughs are now unfilled, because the uplifted ranges near them have remained largely submerged and hence have supplied little or no sediment.

5. The mountain knot of Alaska was raised to its extraordinary height by a convergence of crustal creeping movements. It is precisely in the angle where the southeastward creep of the Aleutian earth-lobe came into conflict with the southwestward creep of northern North America.

6. The peculiar rift valleys on the northern and western sides of Greenland suggest a rending and tearing away of Grant Land, Baffin Land and Labrador from Greenland, due apparently to crustal creep towards the south and southwest, Greenland remaining as the great northern horst. The import of these several facts added together is Tertiary southward crustal creep, with peripheral faulting, folding and uplifting for all the northern continents.

7. Australia's Tertiary peripheral mountain belt lies in island chains seaward from its northern and eastern coasts, indicating northward and eastward crustal creep. South America's belt is on its northern and western sides, indicating northward and westward creep. Thus, the two southern continents show in general northward creep, but with a considerable amount of deflection.

8. The Celebes and Malmahera islands show remarkable "chiragratic" mountain plans, and they are precisely in the zone of conflict between the southward crustal creep of Asia and the northward crustal creep of Australia. Borneo is in the same zone and has a similar mountain plan.

Conclusions.—The foregoing facts show crustal creep in both hemispheres from high towards low latitudes. This is not explicable by any form of contraction hypothesis, but is the normal result of a force tending to deform the lithosphere by slightly and permanently increasing its oblateness—the same in effect as if the earth's axial rotation had been slightly and permanently increased. No contraction hypothesis can account for the occurrence of this remarkable epoch of mountain making at so recent a time as the Tertiary age, unless it can provide some method of storage of mountain making forces which shall endure and continue to accumulate through several geologic ages, with occasional mountain making in moderate degree going on at the same time.

The action of such a force would cause a depression of both polar areas, resulting in crustal creep towards lower latitudes. Inevitably, one polar area would yield before the other or else in greater amount. The pole from which the first large shift of mass took place would ever after take the lead and be the more active area in crustal movement, for that first movement would slightly displace the earth's center of gravity, moving it towards the other pole, where the shift of mass was less, and this change itself would intensify the deforming forces at the first pole and diminish them at the other. Thus, the first pole, corresponding to the north pole of the earth, would progressively emerge from the sea, would suffer the greater deformation and would therefore have an excess of land or continental areas around it, while the other (south) pole would be progressively submerged, would suffer less deformation and would have a minimum of land or continental areas around it. This may explain why the north pole is girdled by land and the south pole by water.

The forces causing southward crustal creep in the northern hemisphere were strongest in high northern latitudes and diminished towards the south; and further, the area of earth-crust upon which the forces acted increased towards the south. Perhaps these two conditions, modified by the tendency to a limited number of meridional rifts due to girth expansion in the equatorial belt, explain the triangular shape of the continents—broad at the north, where a land belt almost girdles the earth, and tapering in sharp points towards the south.

Mr. Taylor's paper was discussed by Professors H. F. Reid, B. K. Emerson, J. Barrell, W. H. Hobbs, A. P. Coleman and F. B. Taylor.

The session then adjourned at 12:30 P.M.

The society convened again in two sections at

2:10 P.M. The first paper presented in the main section, under the chairmanship of President Calvin, was:

On Faults: HARRY FIELDING REID, Baltimore, Md.

This was followed by

Mass Movements in Tectonic Earthquakes: HARRY FIELDING REID, Baltimore, Md.

These papers were discussed by Professor W. H. Hobbs and H. F. Reid.

The next paper was read by title:

The Alaskan Earthquake of 1899: LAWRENCE MARTIN, Madison, Wis. (Introduced by C. K. Leith.)

The society then listened to

A Recent Landslide in a Shale Bank near Cleveland accompanied by Buckling: FRANK R. VAN HORN, Cleveland, Ohio.

The landslide in question took place at the plant of the Cleveland Brick and Clay Company, beginning Monday, August 17, 1908, at 3 P.M., and lasting until late the following day. The shale bank is about 112 feet high and consists of about 3 feet of drift, 21 feet of Cleveland shale and 88 feet of Erie Chaghn shale of the uppermost Devonian. The bank cracked along the valley for a length of 250 feet and followed weathered joint planes almost entirely. The width of the crevice varies up to 22 feet and the vertical displacement is 6 to 7 feet. The mass broken off has been estimated variously up to a million tons, but one hundred thousand tons is probably excessive. After the crevice reached its widest dimensions, the severed block settled back towards the cliff about 1 foot, producing a noticeable dip of the shale layers, at the same time the valley floor at the base of the cliff buckled up into an anticline 4 to 5 feet in the highest portion and traceable over a distance 200 feet. The buckling continued over a period of two months after the crack formed. Buckling is quite often noticed in shales along the edges of stream valleys and it is possible that such movements have been caused by similar landslides.

This paper was discussed by Professors H. P. Cushing, J. W. Spencer, G. B. Richardson, F. R. Van Horn, G. K. Gilbert and G. H. Ashley.

Then was read by title:

The Volcano Kilauea: C. H. HITCHCOCK, Honolulu, Hawaiian Islands.

After this was presented:

Mt. Pelé of Martinique and the Soufrière of St. Vincent in May and June, 1908: EDMUND OTIS HOVEY, New York, N. Y.

The paper gave the results of an expedition made to the Lesser Antilles in April to July, 1908, illustrating by means of lantern slides the progressive changes in 1902, 1903 and 1908 due to the great eruptions and the efforts of nature and man to recover from them.

The last paper of the afternoon was:

Multiple Glaciation in New York: H. L. FAIRCHILD, Rochester, N. Y.

Evidence of pre-Wisconsin glaciation in territory surrounding New York State—in Canada, Ohio, Pennsylvania, New Jersey and New England, implies a similar history for the state.

An accumulating body of fact points to at least two ice invasions. Such features are: (1) the widespread occurrence of more or less difference between the surficial and the deeper till; as shown in color, texture, composition, with sometimes a distinct surface of separation; (2) weathered glaciated surfaces and heavy glacial flutings merely scraped in places by a later abrasion; (3) old planation surfaces which though protected by Wisconsin till have lost their glaciated character; (4) probable stream channels not the product of the latest glacial drainage; (5) physiographic features of anomalous relationship.

No interglacial deposits have as yet been found.

This paper was discussed by Professor G. K. Gilbert, R. S. Tarr, F. Carney, A. Penck and A. P. Brigham.

Adjourned at 5:25 o'clock.

The society met at 8 o'clock Tuesday evening in the lecture room of the geological department to listen to the presidential address of Professor Samuel Calvin, who chose as his theme "The Latest Phase of the Pleistocene Problem in Iowa." This paper will be published in full in SCIENCE.

At the close of the address, the society and its friends adjourned to the rooms above the lecture hall and participated in a "smoker" as the guests of the geological department of the university, the function closing shortly before midnight.

Wednesday morning the society came to order in general session, President Calvin presiding, at 9:35 o'clock, and after the consideration of some matters of business listened to the reading of a letter from Hon. Gifford Pinchot, chairman of the National Conservation Commission, requesting the appointment of a committee by the Geological Society of America with which the commission might confer regarding geological subjects. It was voted to empower the president to appoint three fellows to act as a committee on conservation.

Then was presented a paper by Professor Albrecht Penck, of Berlin, who had been invited by the council to participate in the meeting. Professor Penck chose as his theme "Interglacial Epochs."

At the close of this paper the special section on correlation withdrew for the continuation of its sessions, and the general section, with President Calvin in the chair, proceeded with the main program.

The following two papers were read:

Glacial Waters West and South of the Adirondacks: H. L. FAIRCHILD, Rochester, N. Y.

As the lobes of the ice sheet melted away south of the Adirondacks, high-level waters were held in the Schoharie and Mohawk valleys, into which was poured the land and glacial drainage of the time, with consequent elevated deltas. The Schoharie Lake had outlets to the Hudson and the Delaware; and subsequently the Mohawk waters overflowed southwestward to the Susquehanna, but finally to the Hudson.

The earliest outlet of the Mohawk Valley waters seems to have been by the col at the head of the Otsego-Susquehanna valley, with elevation somewhat under 1,400 feet. A lower escape was found by the Unadilla Valley, at about 1,220 feet, and possibly by the Chenango Valley at 1,150 feet. Later the outflow was eastward to the Hudson by Delanson and Altamont and past the face of the Helderberg scarp, at 840 feet as the lowest. The latest flow of the ice-impounded Mohawk waters was south of Amsterdam and past the face of the scarp at Rotterdam.

The copious drainage of the western slopes of the Adirondacks poured into a lake held in the valley of Black River, with the production of a remarkable expanse of sand plains. In the various features and relations which characterize a glacial lake the Black Lake is probably the finest example of a glacial lake in the state (though not nearly so remarkable in complexity of drainage and history as the Genesee waters). The earliest outflow of the differentiated waters of the Black Valley was southward past Remsen into the Mohawk Lake, with delta built at Trenton and Trenton Falls. The second escape was southwestward, at Boonville, into the inferior Mohawk Lake, with delta north of Rome. The third stage had westward outflow, curving around the high ground between the Black Valley and the Ontario basin, at Copenhagen and Champion, the flood pouring into Lake Iroquois at Adams.

Correlation of the Hudsonian and the Ontarian Glacier Lobes: H. L. FAIRCHILD, Rochester, N. Y.

In the waning of the Labradorian ice body the Adirondack massif became uncovered, at first as an island, with probable westward flow of the ice through the Mohawk depression. Later the glacial flow was divided into a Champlain-Hudson lobe and a St. Lawrence-Ontario lobe. For a long time the Hudsonian lobe pushed an ice tongue westward into the lower Mohawk valley, while the Ontarian lobe sent one eastward into the upper Mohawk valley. Imprisoned between the two opposing ice fronts the glacial waters stood at high levels in the Mohawk and Schoharie valleys. As the waning ice margins released successively lower passes to southern drainage the waters fell accordingly.

The delta sand plains on the flanks of the Adirondacks and in the upper Mohawk valley, with their various declining altitudes, show the successive levels of the waters; and these levels were determined by the positions of the ice margins with reference to a few critical cols or passes on the divide.

These two papers were discussed by Professors A. P. Brigham, H. L. Fairchild and A. W. Grabau.

The next paper was read by title. It was:

Pleistocene Features in Northern New York: H. L. FAIRCHILD, Rochester, N. Y.

Then the society listened to:

Pleistocene Geology of the Southwestern Slope of the Adirondacks: W. J. MILLER, Clinton, N. Y. (Introduced by W. B. Clark.)

The area discussed in the paper is about sixty miles long and fifteen miles wide and extends from Lowville to Dolgeville, N. Y. Certain evidence clearly indicates an early southeasterly movement of the ice, while other evidence shows a later, more general southwesterly direction of flows. The Black River Valley has been considerably deepened and modified by ice erosion. A distinct kame-morainic belt has been traced the whole length of the area. Associated with this moraine are so-called "sand plains," whose origin is discussed. Extinct glacial lakes are shown by the presence of considerable areas of stratified clay. The pre- and post-glacial drainage of the region and the origin of the "gulfs" were discussed.

The paper was discussed by Professor G. K. Gilbert.

Then was read:

Weathering and Erosion as Time Measures: Frank Leverett, Ann Arbor, Michigan.

The paper aimed to set forth the use that may be made of weathering and erosion in determining relative age of the several drift sheets. It also dealt with the most important qualifying conditions that affect estimates.

At the close of the reading of this paper, at 12:30 o'clock, adjournment was taken, discussion being postponed to the afternoon.

The society convened again at 2 o'clock, President Calvin presiding, and took up the discussion of Mr. Leverett's paper, the participants being Professors A. Penck, S. Calvin, F. Leverett, G. F. Wright and G. K. Gilbert.

The next two papers were then read:

The Glacial Phenomena of Southeastern Wisconsin: Wm. C. Alden, Washington, D. C. (Introduced by T. C. Chamberlin.)

A graphic presentation by a map 9 × 10 feet, scale one mile per inch, of a detailed study of the deposits of the Green Bay and Lake Michigan glaciers and associated phenomena of late Wisconsin glaciation of southeastern Wisconsin. The map covers an area approximately 8,600 square miles, which has been under study by the author under the direction of Dr. T. C. Chamberlin, during the greater part of the last ten years. The presentation comprised such description as the time permitted of the conditions affecting the advance of the two glaciers, their relations to each other, the character, distribution and mode of formation of the several deposits, terminal and recessional moraines, outwash deposits, ground moraines, drumlins and eskers, the lithological composition of the drift and its significance. Evidence was presented by a deposit of red till of a later readvance of the two glaciers southward to the vicinities of Milwaukee and Fond du Lac. The shore lines and deposits of Lake Chicago and succeeding glacial lakes were also shown.

Concerning certain Criteria for Discrimination of the Age of Glacial Drift Sheets as Modified by Topographic Situation and Drainage Relations: Wm. C. Alden, Washington, D. C. (Introduced by T. C. Chamberlin.)

The discussion was confined to phases illustrated by the pre-Wisconsin drift of southern Wisconsin and northern Illinois.

Character of this drift and reasons for regarding the drift exposed at the surface throughout this area as belonging to one and the same sheet. The lithological composition and its significance, directions of ice movement, absence of intercalated weathered zones, soils or vegetable deposits.

Differences in the apparent amount of surface modification of this drift in different parts of the area which might be regarded as indicating differences in age:

1. Topographic relations and amount of erosion.

2. Weathering, leaching and oxidation. The occurrence in places of thoroughly disintegrated drift or residual till; in others, of drift but moderately leached and oxidized; in others, of perfectly fresh unmodified drift at the surface or immediately below the loess.

The reasons for these differences:

1. Influence of pre-Glacial topography on drainage slope and upland of the drift. Influence of the St. Peter sandstone on the pre-Glacial topography. Relations of surface wash to the apparent amount of surficial leaching and oxidation.

2. The post-Illinoian diversion of Rock River below Rockford, Illinois, and the consequent retardation of erosion due to the work of cutting new rock gorges at several cols. Removal of the weathered drift from slopes with preservation on the uplands.

Necessity for caution in the discrimination of distant drift sheets in the absence of marked differences in lithological composition or of sections showing overlapping drift with intercalated soils, vegetable deposits or weathered zones.

The two papers together were discussed by F. Leverett.

Then was read:

Lake Ojibwa, the Last of the Great Glacial Lakes: A. P. Coleman, Toronto, Canada.

As the Labrador ice sheet retreated north to the watershed between the Great Lakes and James Bay, the waters now flowing northward were impounded, first as a narrow bay of Lake Algonquin opening south past Sudbury, afterwards as a separate lake with an outlet down the Ottawa Valley. This lake probably existed during the time of the Nipissing Great Lakes, and was the last of the ice-dammed lakes. The elevation of its outlet is now 900 feet, but was then much lower. In its bed the "clay belt" of northern Ontario and Quebec was deposited, having an extent of over 25,000 square miles. The maximum area covered by its waters must have been greater than that of Lake Superior; though probably its extent varied greatly in accordance with the position of the ice front.

This paper was discussed by Mr. F. B. Taylor and Professor A. P. Coleman.

The next paper was:

Glacial Erosion on Kelley's Island, Ohio: Frank Carney, Granville, O.

Last summer a rectangular area about 100 rods long and 4 rods wide was stripped to open a new quarry. This area is transverse to the direction of ice-motion; its southern part does not show the slightest evidence of rasping by stone-shod ice. This rough unglaciated surface ends abruptly in a perfectly smooth, scored area which continues about 800 feet, where it again borders limestone bearing no marks whatever of ice-work. The erosion features thus revealed are so in contrast with the long-known glaciated surfaces near by that the case deserves special consideration.

The paper was discussed by Professor G. F. Wright.

Then was read:

The Chalk Formations of Northeast Texas: O. H. Gordon, Knoxville, Tennessee.

Extending in a west to east direction across the southern part of Lamar County and thence northeast through Red River County to Red River and having a width of from one to three miles, is a belt of chalk known as the Annona chalk from the town in Red River County near which it outcrops. In the earlier publications relating to the Cretaceous of Texas, this formation was considered as the diminished representative of the Austin chalk of central Texas. Later authors, however, have contended that it represents a higher horizon and belongs within the so-called Navarro division of the Upper Cretaceous.

Recent investigations by the author, in connection with the study of the underground waters of northeastern Texas, tend to confirm the earlier view as advanced by Taff that the Annona is the northeastward extension of the Austin formation. Tracing the outcrop of the Annona westward it was found to merge with that of the Austin as exposed in the vicinity of Honey Grove and westward to Sherman. At Austin the formation has a reported thickness of about six hundred feet and is composed essentially of chalk throughout. Toward the northeast the lower beds become marly, the thickness of the chalk marl increasing until in the vicinity of Red River the marls have a thickness of about four hundred feet. To this part of the formation, as represented in northeastern Texas and southwestern Arkansas, Hill applied the name Brownstown beds.

The relations seem to indicate that at the beginning of the Austin epoch the conditions for the formation of pure chalk existed only in the region about Austin, but with the progress of time they were extended farther and farther northeast as a result possibly of a change in the relative position of land and sea.

The next paper was read by title:

Geologic History of the Ouachita Region: E. O. Ulrich, Washington, D. C.

After which was read:

Some Results of an Investigation of the Coastal Plain Formations of the Area between Massachusetts and North Carolina: Wm. Bullock Clark, Baltimore, Md.

The author has under his supervision for the U. S. Geological Survey the investigation and correlation of the coastal plain formations occupying the territory between Massachusetts and North Carolina, inclusive, and has had associated with him in his work a number of co-workers. Some preliminary results of significance have been secured and the formations already studied in detail in New Jersey, Delaware and Maryland have been traced beyond the borders of those regions. The extension of certain of these formations southward through Virginia and North Carolina and the recognition of new members of the coastal plain series have materially added to our knowledge of coastal plain geology. Some of the more significant results of this work were presented.

This paper was followed by the reading of:

The Geologic Relations of the Cretaceous Floras of Virginia and North Carolina: Edward W. Berry, Baltimore, Md. (Introduced by Wm. B. Clark.)

The evidence of the fossil plants concerning the geologic segregation and correlation of the Cretaceous of the Middle Atlantic Slope was presented by the author. Floras similar to those of the adjoining region to the northward have been found at many localities, indicating the extension to the southward of a number of the formations.

The special section on correlation having adjourned, the society then listened in general session to the following papers:

Paleogeography of North America: Charles Schuchert, New Haven, Conn.

The ancient geography of North America, beginning with the Cambrian, was discussed and illustrated by from forty to fifty maps of as many different times. These maps give the probable extent of the marine inundations over the North American continent, and show the extent of the faunal provinces.

The diastrophism indicated by these maps is plotted on a time-geographic curve to show the

extent and duration of the periodic submergences and emergences.

The paper was discussed by Mr. B. Willis.

Revision of the Paleozoic Systems in North America: E. O. Ulrich, Washington, D. C.

Following a brief statement of current and earlier classifications of the Paleozoic rocks and of the evidence, almost solely paleontologic, upon which the present classification is founded, a new grouping of the formations was suggested. The proposed classification is based primarily on crustal movements, diastrophism, the succession of which is determined by the faunal evidence. The occurrence of such movements is determined, aside from plain physical evidence, primarily by mutations in the faunas, especially by the introduction of new faunal elements and facies, and their relative importance by (1) the extent and direction of the submergences and emergences of land-masses induced by the movements and (2) the degree of the corresponding faunal mutations. In determining the boundaries of the various kinds of units, formations, groups, series and systems, the *introduction* of the new faunal elements is insisted on as an essential factor, second in importance only to positive evidence of crustal movements, in producing a scheme of classification having the desirable features of (1) simplicity of arrangement and expression, (2) sharp definition of the major groups, (3) approximate coordination in time values of the various classes of units, (4) a high degree of accuracy in correlation of geographically separated stratigraphic units and (5) the elimination of such hybrid terms as Cambro-Ordovician and Devono-Mississippian. An attempt was made to express the extent and direction of submergences and emergences graphically by a series of curves which it is believed show an appreciable rhythm in occurrence. Considering that the evolution of the scheme involves the determination of the essential contemporaneity of many hitherto not satisfactorily related geologic events, some time was devoted to the discussion of such of the principles of correlation as have been proved by field experience to have the greatest practical value.

Among the changes proposed, the most important is a new system, the Ozarkian, comprising a number of long-misunderstood formations, typically represented in southeastern Missouri and northern Arkansas, but found also in the Appalachian Valley from New York to Alabama, in the upper Mississippi Valley, in Oklahoma, central Texas and elsewhere. Both the upper and lower boundaries of the Ozarkian are defined by more or less marked unconformities. Often the base is in contact with Acadian Cambrian, but at other localities a series of beds or formations, commonly referred to as "upper Cambrian," intervenes.

The top is succeeded by one or another of a great range of formations. In the most complete sections the next strata are of Beekmantown age, in others, however, the succeeding bed is much younger. Concerning the fauna of the Ozarkian, it is to be said that the trilobites and brachiopods, though all new, remind one strongly of preceding Cambrian types. The other classes, among them a host of gastropods and cephalopods, are quite different and on the whole closely allied to Ordovician genera and species.

Suggested changes of comparatively minor import were (1) the correlation of the Richmond with the Medina and, hence, the removal of that group to the Silurian; (2) the restriction of the Devonian to the lower and middle Devonian of current classifications and the transfer of the upper Devonian to the next younger system; finally (3) it was argued that the Meramec and Chester groups of the present Mississippian constitute another system coordinate in value to the Silurian and Devonian.

Mr. Ulrich's paper was interrupted by adjournment at 5:45 P.M. and the reading was finished on Thursday. It was discussed by Professor A. W. Grabau.

At 7 o'clock Wednesday evening the fellows and their friends, to the number of 133, gathered at the Hotel Rennert and sat down together at the annual dinner of the society. President Calvin presided, and, after dinner, remarks were made by him and Messrs. Gilbert, Penck, W. B. Clark, G. O. Smith, Brock, Chamberlin, Hovey, Gulliver, Van Hise, Emerson and Stevenson.

The society convened again at 9:45 o'clock Thursday morning, President Calvin being chairman, and after hearing sundry announcements by the secretary listened to the reading by the secretary of the following report from Professor T. A. Jaggar, Jr., chairman of the committee on earthquake and volcano observations:

"Acknowledgments have been received from the governors of the Leeward Islands, of Hawaii, of Jamaica and of St. Thomas, from the chairman of the Isthmian Canal Commission and from the secretaries of the Smithsonian Institution and of the committee on seismology of the American Association for the Advancement of Science.

"Hon. W. F. Frear, governor of the Hawaiian Islands, writes:

"'Hawaii is an important point for observations of this kind, but how much can be done in this direction is a question. I shall be glad to give what encouragement I can in this matter. The federal government now has a magnetic observatory here, which also contains a seismograph.'

"Wm. Johnstone, Esq., colonial secretary of Jamaica, writes:

"'In reply I am to state for the information of the society that the Weather Service of Jamaica has already in use two seismometers in this island, one at Kingston and one at Chapelton, about the center of the island, and that there are now being constructed here about a dozen seismometers on an improved principle.'

"Col. Geo. W. Goethals, chairman and chief engineer of the Isthmian Canal Commission, writes:

"'We have now at Ancon, Canal Zone, an observatory equipped with a complete assortment of modern, self-recording meteorological instruments, *i. e.*, barograph, air and water thermograph, hydrograph, baragraph à poid, triple register (wind direction and velocity, rainfall and sunshine) and the standard instruments necessary properly to correct their records. We expect shortly to erect two horizontal pendulum Bosch-Omori seismographs—one a hundred-kilogram pendulum instrument (tromometer), which will enable us to obtain registered records on smoked paper of all movements of a telluric nature, either seismic or otherwise, near or distant, and also the variations of the vertical line. The magnification is 100, and the period of oscillation of the tromometer can be extended to forty seconds. Attached to this instrument is an air-damping apparatus, by which the oscillations may be reduced, or even rendered aperiodical. Owing to its sensitiveness, this instrument is well adapted to the registration of earth tremors, pulsatory oscillations, and comparatively quick period earthquake vibrations.

"'The proposed new equipment, therefore, will be such as to enable us to make observations in connection with earthquakes, whether of a tectonic nature, or produced by volcanic action, as well as of other physical phenomena, such as earth tremors and pulsations, which may, as premonitory signs, have a bearing on the prediction of earthquakes. We are also prepared to study the relations that may exist between seismic disturbances, pressure and temperature.

"'While we can not make our studies cover the entire field of seismology, we believe our observations will be of considerable utility in the work that the Geological Society of America has undertaken.'

"The chairman of your committee has to report for his own district that, through the efforts of Professor J. B. Woodworth, Harvard University has installed a seismograph which is in active operation, and that money has been given by citizens of Boston whereby another Bosch-Omori instrument has been secured, and plans and drawings are now under consideration with a view to the building of a geophysical observatory near Boston which will be under the direction of the department of geology of the Massachusetts Institute of Technology."

The secretary reported from the council the constitution of W. B. Clark, H. E. Gregory, C. W. Hayes, J. M. Clarke and E. O. Hovey a committee to confer as to details with a committee of organization which had been chosen by certain paleontologists desiring to form a Paleontological Society as a section of and in close affiliation with the Geological Society of America, the council heartily commending the project. On motion the action of the council was endorsed and the committee given authority to act for the society.

The society then divided into two sections, as on Wednesday afternoon, and the following papers were presented under the chairmanship of President Calvin:

A Classification of Crystals based upon Seven Fundamental Types of Symmetry: CHARLES K. SWARTZ, Baltimore, Md.

A new and elementary development of the 32 groups of crystals was given, showing that all crystals fall into seven fundamental divisions based upon symmetry which are independent of the seven systems of crystals. Each of these types was characterized and a classification of crystals upon this basis was proposed. It is believed that the recognition of these divisions greatly simplifies the presentation of the subject of crystallography.

This paper was discussed by Professors W. H. Hobbs, E. H. Kraus, W. N. Rice and H. B. Patton.

The following paper was presented by title:

The Use of "Ophitic" and Related Terms in Petrography: ALEXANDER N. WINCHELL, Madison, Wis.

Then was read:

Chemical Composition as a Criterion in Identifying Metamorphosed Sediments: EDSON S. BASTIN, Washington, D. C. (Introduced by G. O. Smith.)

This paper called attention to the small number of definite statements, even of a qualitative char-

acter, in geological literature, as to the nature and value of chemical criteria in distinguishing schists of sedimentary from those of igneous origin. Quantitative statements are wholly wanting.

By compiling a large number of analyses of pelitic sediments the writer showed the nature of the chemical changes involved in their metamorphism. He then proceeded to contrast the composition of the pelitic schists and gneisses with that of their allies among igneous rocks. The calculation of the "norm" of a schist and its classification according to the quantitative system of Cross, Iddings, Pirsson and Washington was pointed out as a convenient method for making such comparisons.

These statistical studies brought out not only the character of the chemical criteria which may be used, but gave a quantitative measure of their value. The paper concluded with the application of these criteria to certain selected schist and gneiss analyses.

The discussion on this paper was participated in by Professors B. K. Emerson, W. S. Bayley, F. D. Adams and E. S. Bastin.

After this the following paper was read by title:

Petrology of the South Carolina Granites (Quartz Monzonites): THOMAS LEONARD WATSON, Charlottesville, Va.

The next two papers, being on related topics, were presented in succession:

Tertiary Drainage Problems of Eastern North America: AMADEUS W. GRABAU, New York City.

The Laurentian River of Spencer carried the collected drainage of the Great Lakes through Ontario Valley and out by the way of the present St. Lawrence. The Finger Lake valleys and the Genesee are regarded as made by tributary northward flowing streams. Fairchild regards these as northward-flowing tributaries of a (possibly) westward-flowing river in the Ontario Valley. The author has in the past shown that a normal sequential drainage system, the general direction of which was northward, and in which the minor streams were beheaded by the master, accounted for all the topographic features of the region in question. Subsequent blocking of some of the channels by drift and deepening of others by ice, and a general depression of the country to the northeast, has produced the present drainage system. The problems were discussed in the light of accumulated facts.

Drainage Evolution in Central New York: H. L. FAIRCHILD, Rochester, N. Y.

The paper aimed to assist in the elucidation of the complete physiography of the west half of New York State. Three maps represented graphically the general evolution of the drainage and the interference by glacier invasion of the normal stream development.

The first map showed the existing valleys which are an inheritance from the primitive (consequent) drainage, southwestward, across the uplifting coastal plain. These inherited valleys fall into three classes: (*a*) those in which the present flow is the same as the primitive, (*b*) those which are abandoned or left as "hanging" valleys and (*c*) those in which the stream flow has been reversed. A remarkable parallelism is exhibited by these valleys, which, except in the district of the Delaware and upper Susquehanna, are transverse to the present master streams. The primitive Susquehanna continued directly south at Lanesboro, instead of bending northwest as now, and occupied in Pennsylvania the Tunkannock Valley. Other valleys in northern Pennsylvania represent the continuation of the southwestward flow in central New York.

The second map exhibited the hypothetical Tertiary drainage. During Mesozoic and Tertiary time all the drainage of the west half of the state was diverted westward (subsequent) and northward (obsequent) into a great trunk stream that occupied the Ontario and Erie valleys and probably drained westward into the Mississippi basin. The cause of this radical reversion of flow was the great thickness of non-resistant rocks in the Ontario district. In the vertical series of strata between the Trenton and the Portage, on the Cayuga meridian, are 5,150 feet of rock of which 4,500 feet are weak shales, 350 feet limestone and 250 feet sandstone.

The pre-Glacial divide was far south in Pennsylvania. The Allegheny system poured north through the lower Cattaraugus Valley. The upper Genesee was tributary to the broad Dansville-Avon River, which almost certainly had its northward course through the Irondequoit Valley. The Susquehanna turned west from the site of Lanesboro and Susquehanna villages along the strike of the Chemung strata, which were less resistant than the overlying Catskill, past the sites of Binghamton, Owego and Waverly, and then curved north through the sites of Elmira and Horseheads and occupied the Seneca Valley. The Chemung was the principal tributary from the west, as to-day, but it passed north of Elmira instead of south, where it now lies in a post-Glacial cut.

The Delaware and the upper tributaries of the

Susquehanna were not diverted from their southwest courses.

Along the Ontario lowland the Tertiary channels are almost entirely destroyed or obscured by drift, but the valleys of Irondequoit, Sodus, Little Sodus and Fairhaven are trenches across the Niagara-Medina scarp which probably represent the northward pre-Glacial flow. To-day only two large streams pass across this rock ridge, the Genesee and Oswego, both in new channels. It seems probable that along the belt of Salina outcrop the pre-Glacial tributary streams flowed east or west as they do to-day.

It was suggested that the "oversteepened" walls of the bottom sections of the Finger Lakes valleys were produced by the rapid down-cutting of the streams during the Tertiary uplift.

The third map showed the principal stream flow as compelled by the ice sheets. A few strong south-leading valleys were enlarged or newly cut by the concentrated glacial waters, and the Allegheny and Susquehanna systems were turned to the south. In order from west to east the glacially developed valleys are Cassedaga, Conewango, Ischua, Canisteo, Cohocton, Cayuta, Cattatonk, Tioughnioga. These southeastward drainage lines, transverse to the primitive flow, were carved from numerous, short, subsequent valleys by stream flow forced to the southward by the ice-damming. Such flow was effective during the advance of the ice sheet, but stronger during the waning of the ice; and probably more than one ice invasion has been concerned.

On the Ontario lowland the forced drainage was west or east, alongside the ice margin. In the Erie basin the later flow was all westward past the ice front. In the Mohawk Valley the drainage between Little Falls and Rome was turned from west to east.

The water-parting which in pre-Glacial time lay in Pennsylvania has been so changed by glacial flow that it now lies close to the Finger Lakes.

These papers were discussed together by Professors A. W. Grabau, J. W. Spencer, F. Carney, A. P. Brigham, G. F. Wright, F. B. Taylor, A. P. Coleman and H. L. Fairchild.

At 12:40 o'clock the society adjourned for luncheon, meeting again at 2:05 o'clock to continue the reading of papers. President Calvin occupied the chair. The first two papers were read by title. They were:

Some Physiographic Features of the Shawangunk Mountains: GEORGE BURBANK SHATTUCK, Poughkeepsie, N. Y.

Nantucket Shorelines, III.: F. P. GULLIVER, Norwich, Conn.

Then was presented:

Nantucket Shorelines, IV.: F. P. GULLIVER, Norwich, Conn.

The writer has not been able to continue as fully as would have been desirable the detailed study of the island of Nantucket and its changing shoreline, on account of the cost of oft-repeated observation and survey. Some results of further study since the last report made to the society were given.

The strong north and northeast storms of the past fall have closed the Haulover, and the tombolo from Wauwinet to Coskata was completed on November 12, 1908. Some old maps have been studied with reference to the former eastward extension of the oldland at Wauwinet, Coskata and Folger islands. The changes on Great Point since 1896 were compared with previous conditions and with what may be expected in future. The shoals between Nantucket and Cape Cod, and between Nantucket and Martha's Vineyard and the Hyannis shore are considered as attempts of the sea to build tombolos.

After this was presented:

Note on Striations, U-shaped Valleys and Hanging Valleys produced by other than Glacial Action: EDMUND OTIS HOVEY, New York City.

The volcanic sand-blasts due to the eruption of Mt. Pelé produced striations and grooves in the material over which they passed that strongly resemble the striations and grooves produced by ice action. The heavily burdened streams of the Soufrière of St. Vincent have carved out rock channels of typical U-shape in the old lava flows of the volcano. Hanging valleys have been produced by the sea eroding more rapidly than the streams.

The paper was discussed by Professor A. Penck.

Then was read by title:

Historical Notes on Early State Surveys: GEORGE P. MERRILL, Washington, D. C.

The next paper was:

The Iron Ores of Maryland: JOSEPH T. SINGEWALD, JR., Baltimore, Md. (Introduced by W. B. Clark.)

This paper presented a brief summary of the results of an investigation carried on during the past season on the iron ores of Maryland under the auspices of the Maryland Geological Survey. Four classes of ore were recognized—limonite, hematite, magnetite and siderite. The paper presented embraced a discussion of the character and

chemical composition of each of these ores, the localities in which the deposits occur, and also their geologic and stratigraphic relations.

After this was presented:

The Shortage of Coal in the Northern Appalachian Field: I. C. White, Morgantown, W. Va.

The next paper was read by title:

Glacial Character of the Yosemite Valley: François Matthes, Baltimore, Md. (Introduced by Wm. Bullock Clark.)

Then was presented:

The Mills Moraine with some discussion of the Glacial Drainage of the Longs Peak (Colorado) District: Edward Orton, Jr., Columbus, Ohio. (Introduced by F. P. Gulliver.)

This paper was discussed by Mr. W. T. Lee.

The next paper read was:

Quartz as a Geologic Thermometer: Fred E. Wright and E. S. Larsen, Washington, D. C.

Observations by Le Chatelier and Mallard in 1889–1890 proved that at about 570° quartz crystals undergo a reversible change, the expansion-coefficient, birefringence and circular polarization all changing abruptly. O. Mügge (*Neues Jahrbuch, Festband*, 1907, 181–196) has recently considered the problem again in detail and by means of etch figures combined with crystallographic behavior on heating found that below the inversion point quartz crystallizes in the trapezohedral-tetartohedral division of the hexagonal system, while above 570° it is trapezohedral-hemihedral. The high form is very similar to the low form and differs chiefly in the fact of its common planes of symmetry. A plate formed above 570° is trapezohedral-hemihedral, but on cooling it changes to the trapezohedral tetartohedral division, thereby losing its common planes of symmetry, which may then become twinning planes. It is to be expected, therefore, that quartz crystals thus cooled will be irregularly and intricately twinned after (1010.), while low temperature quartzes are simple or regularly twinned. It is furthermore evident, on considering the genesis of quartz at different temperatures, that intergrowths of right- and left-handed quartz are limited chiefly to quartz crystals formed below 570°. These two criteria can be used to distinguish quartz which has been formed or heated above 570° from quartz which has never reached that temperature. The object of the present investigation has been to test the general validity of the theoretical conclusions on a number of quartzes from different kinds of rocks and veins, as well as to determine more accurately the inversion temperature.

SECTIONAL MEETING FOR PAPERS ON STRATIGRAPHIC, AREAL AND PALEONTOLOGIC GEOLOGY

The section was called to order at 10 o'clock Thursday morning by Professor W. B. Clark, who was then elected presiding officer. Professor E. R. Cumings acted as secretary throughout, by request of the secretary of the society.

The first paper read was:

Occurrence of the Magothy Formation on the Atlantic Islands: Arthur Barneveld Bibbins, Baltimore, Md.

The Magothy formation (of mid-Cretaceous age), as originally defined by Darton, was supposed by that author to be limited to the state of Maryland, although its partial equivalent, the "alternate clay-sands," was earlier mentioned by Uhler as occurring much farther northward. Recent investigations, paleobotanical and stratigraphic, by Hollick, Berry and the writer have extended the lines of the formation far southward, and northward across New Jersey and along the Atlantic Islands as far as Marthas Vineyard. The occurrence upon these islands was shown by local sections and photographs. The deposits are richly plant bearing, with grains of amber associated, as on the Magothy River. The formation suffered considerable corrugation by the great ice sheet.

The paper was discussed by Dr. David White and Professor A. B. Bibbins.

The next paper presented was:

Erosion Intervals in the Tertiary of North Carolina and Virginia and their bearing upon the Distribution of the Formations: Benjamin L. Miller, South Bethlehem.

Recent investigations have furnished evidence of several uplifts and subsidences during Tertiary time in North Carolina and Virginia that have determined the present distribution of the formations. These have affected large areas at certain periods but at other times have been localized.

Then followed:

The Character and Structural Relations of the Limestones of the Piedmont in Maryland and Virginia: Edward B. Mathews and J. S. Grasty, Baltimore, Md., and Charlottesville, Va.

A study of the small bodies of crystalline limestones and marbles found along the western edge of the Piedmont from Pennsylvania to North Carolina shows that their occurrences mark the tops of tightly compressed anticlines. The deposits on either side are usually metamorphosed volcanics—flows and tuffs—which in the normal

section lie far beneath the limestones. The areal distribution, contacts and structural lines point to a strong overthrust fault of wide extent.

This paper was discussed by Professor J. Barrell.

After this was read:

Recurrence of the Tropidoleptus Fauna and the Geographic Range of Certain Species in the Chemung of Maryland: CHARLES K. SWARTZ, Baltimore, Md.

The recurrence of *Tropidoleptus* and associated species of Hamilton type above the base of the Chemung of Maryland was noted. Certain diagnostic species of the Chemung, particularly those of the genera *Douvillina* and *Dalmanella*, appear to be of rare occurrence east of the Allegheny Front. The significance of this fact was discussed.

Discussion of the foregoing paper was participated in by Professors H. S. Williams, H. F. Cleland, Charles Schuchert, C. K. Swartz, J. M. Clarke, Stuart Weller, E. R. Cumings and C. S. Prosser.

Then was read:

The Geological Distribution of the Mesozoic and Cenozoic Echinodermata of the United States: WM. BULLOCK CLARK and M. W. TWITCHELL, Baltimore, Md., and Columbia, S. C.

The authors presented the results of an investigation of the Mesozoic and Cenozoic echinodermata of the United States, particularly in reference to the geological distribution of the forms studied. Representatives of the echinodermata are found at most horizons, but are numerous and significant in the Cenozoic and Tertiary rocks, where they at times become important forms for the determination of geologic horizons. The Upper Cretaceous formations both of the Atlantic and Gulf states have afforded a large number of important species.

The paper was discussed by Dr. J. M. Clarke and Professor W. B. Clark.

The next paper read was:

On the Age of the Gaspé Sandstone: HENRY S. WILLIAMS, Ithaca, N. Y.

A review of the evidences upon which has been based the opinion that the marine fauna at the base of the Gaspé sandstone is of the Hamiltonian epoch, and a presentation of the evidence for the view that these marine beds, as well as those of Pictou iron ore beds of Nova Scotia, Moose River sandstone of Maine and the upper beds of the St. Helen's Island conglomerate and of Côte St. Paul, are not of later age than the Oriskany beds immediately underlying the Onondaga limestone of North Cayuga, Ontario or Schoharie grit of eastern New York, at which epoch it is inferred marine connection with the Atlantic basin was cut off.

The Owl's Head and Chaudière River beds were explained by supposing the opening of a channel westward, connecting with Indiana basin and southwest at beginning of the succeeding Onondaga epoch.

The paper was discussed by Professors J. M. Clarke, Charles Schuchert, H. S. Williams and A. W. Grabau.

The section adjourned at 12:30 P.M. and met again at 2:15 P.M. with Professor W. B. Clark in the chair.

The following two papers were read by title:

The Aftonian Sands and Gravels in Western Iowa: BOHUMIL SHIMEK, Iowa City, Iowa.

An Aftonian Mammalian Fauna: SAMUEL CALVIN, Iowa City, Iowa.

Then was presented:

The Brachiopoda of the Richmond Group: AUGUST F. FOERSTE, Dayton, Ohio.

In the area dominated by the Cincinnati geanticline there have been several invasions of the brachiopoda considered most typical of the Richmond group. The first of these occurred near the middle of the deposition of the Arnheim bed. The Richmond group of the Mississippi Valley, as far as may be determined from a study of the brachiopoda, finds nearer representatives in the upper or Blanchester division of the Waynesville bed and in the Liberty bed, than in the Arnheim, lower Waynesville or Whitewater beds. A study of the distribution of the brachiopoda in Ohio, Indiana and Kentucky suggests that the centers of distribution lay more frequently toward the northeast than toward the northwest or west of the present areas of exposure. To account for this it is imagined that the Richmond group of the Ohio Valley was connected with that of the Mississippi Valley by way of northern Indiana and Illinois. Possibly, if the areas now covered by overlying formations could be exposed, the Richmond brachiopoda would be found to be absent in southern Indiana and Illinois and in western Kentucky, west of the present areas of exposure of these fossils in the region of the Cincinnati geanticline. Lithological conditions within the areas dominated by this geanticline favor this view.

Professor E. R. Cumings discussed this paper.

After this, the following paper was read:

The Trap Sheets of the Lake Nipigon Basin: ALFRED W. G. WILSON, Montreal, Canada.

The well-known trap sheets which form one of the most salient geologic features of the north shore of Lake Superior, are usually regarded as intrusive in origin and of the nature of laccolitic sills. In the basin of Lake Nipigon, lying north of Lake Superior, on the Laurentian peneplain, the trap sheets are found to rest either directly upon the Archean rocks or upon small outliers of the sediments, often many miles distant from the main areas of similar age. The traps are known to rest unconformably upon at least five different earlier formations. This unconformity can be explained by attributing to the fluid traps the ability to insinuate themselves, in an extremely intricate manner and over a very large area, between overlying sediments and underlying crystallines, here and there masses of the sediments remaining so firmly attached to the bed on which they rested that the traps flowed over and around them, cutting across the beds.

While many of the trap sheets along the north shore of Lake Superior are undoubtedly laccolitic sills, still the writer is inclined to believe that the balance of evidence shows that these sills are confined largely to the areas underlain by sediments of later date than the Archean. A simpler explanation, and one that appeals to the writer as more reasonable, of the relations known to exist between these trap sheets and the underlying rocks in the Nipigon basin, is that, at least along the line of the escarpments which mark the boundary between the sediments and the Archean areas to the north and out upon the old land itself, the same traps flowed over an eroded surface of subaerial origin.

Incidentally there is strong, though not conclusive, evidence for considering that these flows might be even of post-Cretaceous age.

This paper was discussed by Professors A. W. Grabau, A. W. G. Wilson, A. C. Lane and A. F. Foerste.

Then was read:

Reconnaissance in Arizona and Western New Mexico along the Santa Fé Railroad: N. H. DARTON, Washington, D. C.

The reconnaissance was made for the purpose of ascertaining the prospects for deep wells to supply water to the railroad and settlements along its line. The region examined was from ten to forty miles wide and in this area the principal structural and stratigraphic features of formations from Cambrian to Cretaceous were determined.

This was followed by the reading of:

Geologic Studies in the Alaska Peninsula: WALLACE W. ATWOOD. (Introduced by A. H. Brooks.)

Detailed work was done in the vicinity of Chignik, Balboa and Herendeen bays and on the Island of Unga. The Balboa-Herendeen Bay district was selected as a type area in the peninsula, and detailed studies were pursued in the hope of working out a key to the general geologic conditions of this portion of Alaska.

The formations exposed include the Upper Jurassic, Lower and Upper Cretaceous, marine and freshwater Eocene, Miocene, possibly some Pliocene, Pleistocene and recent Kenai plants were found associated with marine invertebrate shells of Upper Eocene age.

Vast quantities of igneous rocks have been intruded into the sedimentary series, and overlying a portion of the area there are volcanic tuffs and basic flows of post-Miocene age.

Coal occurs in the Upper Cretaceous and Eocene. Gold and copper prospects were examined at several localities.

Then was presented:

Present Knowledge of the Oklahoma Red Beds: CHARLES N. GOULD, Norman, Okla.

After this was read:

The Fauna of the Fern Glen Formation: STUART WELLER, Chicago, Ill.

The Fern Glen formation is typically developed in St. Louis and Jefferson counties, Missouri, and Monroe County, Illinois. It lies at the summit of the Kinderhook group and consists of beds of red calcareous shales and red limestones, with a maximum thickness of about forty feet. The upper beds are more greenish in color and merge gradually into the superjacent Burlington limestone. The fauna is distinctly a member of the southern group of Kinderhook faunas and consists for the most part of corals, crinoids and brachiopods, with a few blastoids, molluscs and trilobites. Many of the species are undescribed, although more or less closely related to known forms in other Kinderhook faunas or in the Burlington limestone. The correlation of the fauna is with those of the basal Knobstone shales of Kentucky, the St. Joe marble of Arkansas and the Lake Valley beds of New Mexico.

The paper was discussed by Professors Charles Schuchert, Stuart Weller and E. O. Ulrich.

The next two papers were read by title:

Age and Geologic Relations of the Sankaty Beds, Nantucket: W. O. CROSBY, Boston, Mass.

Age and Relations of the Sankaty Beds: H. W. SHIMER, Boston, Mass. (Introduced by W. O. Crosby.)

Then the following paper was read:

Some Features of the Wisconsin Middle Devonic: H. F. CLELAND, Williamstown, Mass.

This paper gave the results of a study of all the outcrops, as far as known, of the Wisconsin Devonic and their contained faunas. In it were discussed: (1) the relation of the strata to those above and below, (2) the unconformities, (3) the lithological characters and (4) the character, relationships and geographical distribution of the faunas.

Professors Charles Schuchert, A. W. Grabau and H. M. Ami participated in the discussion of this paper.

The next paper read was:

Ice-borne Bowlder Deposits in mid-Carboniferous Marine Shales: JOSEPH A. TAFF, Washington, D. C.

Great numbers of bowlders and other erratic fragmental rock débris occur in the Caney formation of the Ouachita Mountain region in southeastern Oklahoma. The erratic material consists of bowlders, cobbles and small rock fragments of three general classes, namely: (1) limestones, siliceous, argillaceous and magnesian; (2) flints, cherts and (3) quartzites.

The limestones are of various textures and colors, some of which partake of the nature of the quartzites, while others are argillaceous; others yet appear to be dolomitic or perhaps dolomites. Many of the limestone bowlders are massive and homogeneous, while others are distinctly stratified and contain two or more classes of limestone, or strata of limestone and flint.

Flint and chert bowlders are also of common occurrence, and in places are even more abundant than the limestone bowlders. Certain of these flints are stratified or bedded and are black or bluish in color, while others are massive, chalcedonic in character and contain inclusions of drusy quartz. Among these are many of conglomerate and brecciated nature.

The third group in the general classification of these erratics includes quartzites of dark and reddish hues.

These erratic bowlders vary in size from small pebbles to bowlders of enormous size, a few of which attain lengths of more than fifty feet. Many of the smaller bowlders are more or less rounded, while a few are quite perfectly so. The larger ones are, as a rule, angular.

At three separate localities in the Ouachita Mountain region certain of the limestone and flint bowlders contain grooves and striæ as if produced by the action of shore ice. Certain of these striæ also resemble the markings of slickensided surfaces. The evidence as to the origin of these gouged surfaces is not conclusive.

The erratic bowlders contain a comparatively abundant Ordovician and Silurian fauna. The bowlders are promiscuously scattered in the Caney formation of black and blue shale with local beds of sandstone in the upper part.

The Caney formation is several hundred feet thick and contains limy concretions or segregations, associated with the erratic bowlders and elsewhere, that contain an abundant fauna of late Mississippian or early Pennsylvanian age.

The area of bowlder-bearing beds of the Caney formation, as now known, is within the Ouachita Mountain uplift in Oklahoma that extends within a few miles of the Arkansas line to the west end near Atoka.

The structure of the region is typically Appalachian, the rocks being closely folded and thrust northward.

Upon comparison, both lithologically and faunally, the erratic bowlders are found to contain identical characteristics in the Cambro-Ordovician and Silurian rocks in the Ouachita Mountain region of Oklahoma and in the Cambro-Ordovician section in north-central Texas. There are evidences of emergence of the rocks of mid-Carboniferous time in the western part of the Arbuckle uplift and in the Texas region to the southwest that affect the Cambro-Ordovician and Silurian rocks. The tentative conclusion is that the bowlders were transported from a land to the south by the agencies of ice.

This paper was discussed by Messrs. David White, W. C. Alden and J. A. Taff.

The last paper on the sectional program was:

Relationships of the Pennsylvanian and Permian Faunas of Kansas and their Correlation with Similar Faunas of the Urals: J. W. BEEDE, Bloomington, Ind.

Owing to physical changes which occurred during the close of Pennsylvanian time, there occurred a great reduction of Pennsylvanian species, followed by the introduction of Permian species. This introduction of new species becomes very noticeable in the Elmdale formation and its base is considered the base of the Kansas Permian. The Permian, as here understood, includes the

Artinskian and "Permo-Carboniferous" of Eurasia.

REPORTS OF COMMITTEES

Through Mr. Arthur Keith the Committee on Geologic Nomenclature reported that it had organized by the election of Professor T. C. Chamberlin as chairman and Mr. A. Keith as secretary. The committee is constituted as follows:

For the Geological Society of America: Professors T. C. Chamberlin and W. B. Scott.

For the U. S. Geological Survey. Mr. Arthur Keith and Dr. David White.

For the Association of State Geologists: Dr. J. M. Clarke and Professor E. A. Smith.

For Canada—Geological Survey: Professor F. D. Adams. Other official surveys: Dr. W. G. Miller.

For Mexico: Dr. J. G. Aguilera and Dr. C. Burckhardt.

The Photograph Committee, Mr. N. H. Darton, reported that there had been few accessions during the year and practically no use of the collection.

On account of the length of the program the council formed a special section for the consideration of certain papers forming part of a symposium on correlation which had been arranged for by Mr. Bailey Willis, chairman, and Dr. F. P. Gulliver, secretary, of Section E (Geology and Geography) of the American Association for the Advancement of Science. For the sake of record the whole list of these papers, with the times when they were read, follows.

MONDAY, DECEMBER 28

Before Section E. (By title in G. S. A. program.)

Pre-Cambrian

11:00 A.M. to 12:10 P.M.

C. R. Van Hise: "Principles of Pre-Cambrian Correlation."

F. D. Adams: "The Basis of Pre-Cambrian Correlation."

Early and Middle Paleozoic

3:30 to 4:00 P.M.

C. D. Walcott: "Evolution of Early Paleozoic Faunas in Relation to their Environment."

4:00 to 5:50 P.M.

A. W. Grabau: "Physical and Faunal Evolution of North America in the Late Ordovicic, Siluric and Devonic Time."

4:50 to 5:30 P.M.

Stuart Weller: "Correlation of Middle and Upper Devonian and Mississippian Faunas of North America."

TUESDAY, DECEMBER 29

Before a temporary section of the G. S. A.

Late Paleozoic

11:00 A.M. to 12:05 P.M.

G. H. Girty: "Physical and Faunal Changes of Pennsylvanian and Permian in North America."

David White: "The Upper Paleozoic Floras, their Succession and Range."

Vertebrates

2:00 to 3:15 P.M.

S. W. Williston: "Environmental Relations of the Early Vertebrates."

H. F. Osborn: "Environment and Relations of the Cænozoic Mammalia."

Mesozoic and Tertiary

3:15 to 4:00 P.M.

T. W. Stanton: "Succession and Distribution of Later Mesozoic Invertebrate Faunas."

4:00 to 5:15 P.M.

W. H. Dall: "Conditions Governing the Evolution and Distribution of Tertiary Faunas."

Ralph Arnold: "Environment of the Tertiary Faunas of the Pacific Coast."

WEDNESDAY, DECEMBER 30

Before a temporary section of the G. S. A.

Tertiary and Quaternary

10:50 to 11:25 A.M.

F. H. Knowlton: "Succession and Range of Mesozoic and Tertiary Floras."

11:25 A.M. to 12:25 P.M.

R. D. Salisbury: "Physical Geography of the Pleistocene with Special Reference to Conditions Bearing on Correlation."

D. T. MacDougal: "Origination of Self-generating Matter and the Influence of Aridity upon its Evolutionary Development."

2:30 to 3:45 P.M.

T. C. Chamberlin: "Diastrophism as the Ultimate Basis of Correlation."

After the reading of scientific papers had been finished, the society met again in general session and Professor J. M. Clarke proposed a vote of thanks to the citizens of Baltimore, the authorities of the Johns Hopkins University and in particular to the members of the department of geology for the welcome accorded to the society and the particularly complete arrangements made for the work of the meeting and the comfort and enjoyment of those in attendance. The vote was

most heartily passed and was responded to by Professor W. B. Clark in behalf of the Baltimoreans concerned.

The society adjourned shortly before 5:00 P.M., on Thursday, December 31.

The following officers were elected by the society for the year 1909:

President—Grove K. Gilbert, Washington, D. C.

First Vice-President—Frank D. Adams, Montreal, Canada.

Second Vice-President—John M. Clarke, Albany, N. Y.

Secretary—Edmund Otis Hovey, New York City.

Treasurer—William Bullock Clark, Baltimore, Md.

Editor—Joseph Stanley-Brown, Cold Spring Harbor, N. Y.

Librarian—H. P. Cushing, Cleveland, Ohio.

Councilors (1909–1911)—George Otis Smith, Washington, D. C., and Henry S. Washington, Locust, N. J.

The following were elected as fellows of the society: Elliot Blackwelder, Madison, Wis.; William Phipps Blake, Tucson, Ariz.; Charles Wilson Brown, Providence, R. I.; Frank Carney, Granville, Ohio; Edward Salisbury Dana, New Haven, Conn.; Cassius Asa Fisher, Washington, D. C.; Albert Johannsen, Washington, D. C.; Geo. Frederick Kay, Iowa City, Iowa; Henry Landes, Seattle, Wash.; George Burr Richardson, Washington, D. C.; Joaquim Candido da Costa Sena, Ouro Preto, Minas, Brazil; Earle Sloan, Charleston, S. C.; George Willis Stose, Washington, D. C.; Charles Kephart Swartz, Baltimore, Md.

One hundred thirty-five fellows were in attendance, making this second Baltimore meeting the largest in the history of the society. The council voted to hold the next winter meeting in Boston and Cambridge.

EDMUND OTIS HOVEY,
Secretary

SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 455th meeting was held February 20, 1909, with President Palmer in the chair. Dr. M. W. Lyon, Jr., exhibited the skins of two weasels from the vicinity of Washington, D. C. One was taken in the middle of the relatively mild winter of 1906–7 and showed the light brown pelage of long fur, characteristic of the winter pelage of weasels in this latitude. The other was taken in the latter part of March, 1904, and was mainly in the white winter pelage characteristic of weasels in higher latitudes. The middle line of the back showed the dark brown shorter summer pelage coming in. The winter of 1903–4 was colder than that of 1906–7. Whether that had anything to do with causing a white pelage instead of a light brown one could not be said.

The following communications were presented:

Some Japanese Entomologists and their Laboratories, with Notes on the Introduction of Parasites of the Gypsy Moth: L. O. HOWARD.

Dr. Howard spoke of some Japanese entomologists and their laboratories, and of the recent work in importing parasites of the gypsy moth and the brown-tail moth. He described some of the recent innovations in the large-scale experiment which has been carried on for three years by the Bureau of Entomology of the U. S. Department of Agriculture in the importation of parasites from Europe and from Japan, most of which have been mentioned in the annual report of the Chief of the Bureau of Entomology for 1908. He spoke especially of a trip to Japan taken during the summer of 1908 by Professor Trevor Kincaid, of the University of Washington (Seattle), as an agent of the bureau, to collect and send to the United States the Japanese parasites of the gypsy moth. This expedition was highly successful, and Mr. Kincaid met with the most gracious courtesy and the most hearty cooperation on the part of the Japanese entomologists. The talk was illustrated by lantern slides showing groups of Japanese entomologists at different agricultural colleges and experiment stations, as well as at private stations, and also of the experiment station buildings and laboratories.

Some Remarkable Phenomena Occurring in the Breeding of Varieties of Dianthus: J. B. NORTON.

Since 1904 several hundred seedling carnations have been grown each year by Mr. E. M. Byrnes, of the Bureau of Plant Industry, in the greenhouses of the Department of Agriculture. From the notes and records kept of these seedlings by the speaker, it was found that about 23 per cent. of the seedlings were typical single flowered, the remainder being double. The double flowers could be divided into two groups—standard doubles, *i. e.*, like the parent varieties, and full doubles, or "bull-heads"; the latter class averaging about 25 per cent. of the total number of seedlings. The close agreement of these percentages was that of a second generation of a Mendelian hybrid, which led to the prediction that the commercial carnation was a hybrid type and that the single and bull-head types were the extracted pure parent

forms. Experiments were carried on to determine this point by crossing single-flowered plants with the pollen of the full doubles. Out of three hundred seedlings in 1906 from crosses of this kind only two singles were found, the remainder being standard, or hybrid doubles. These two singles could have been from accidental pollination with pollen from other singles, since the flowers were not covered. Singles crossed with singles gave nothing but single-flowered seedlings. The full doubles failed to set seed on account of their defective ovaries, which were often changed into collections of petal-like organs. This work has since been repeated by other breeders with perfect results under control conditions. The double flowers are interesting in that doubling is accomplished in the same flower by increase in the number of whorls of petals, by change of stamens into petals, and by basal branching of large petals into a number of smaller ones. These three methods seem to be associated as one character. In the intermediate hybrid the three methods of doubling all appear, but in reduced form.

For many generations the parents of the American carnation varieties have been uniformly of the hybrid type, but as yet we have no instance of it reproducing true to type by seed, the two parent types constantly reappearing in about their normal proportions. Other characters, such as dwarf habit, short calyx, clove scent, color, variegated petals, etc., seem to follow the same law of heredity. Since *Dianthus caryophyllus* is normally strongly proterandrous and carnation breeders in the past have uniformly practised wide cross breeding, so that, if anything, the vigor of the type is constantly increasing, it is interesting to note the occurrence of Mendelism in this group, as recent unsupported theories have claimed that such should not be the case.

M. C. MARSH,
Recording Secretary

THE TORREY BOTANICAL CLUB

THE meeting of February 24 was held at the Museum of the New York Botanical Garden at 3:30 P.M. In the absence of the president and both vice-presidents, Mr. Fred J. Seaver was called to the chair.

The following scientific program was presented:

Collecting Fungi in Jamaica: Dr. W. A. MURRILL.

This paper has been published in the February *Journal of the New York Botanical Garden.*

Cypripedium in the Light of its Segregates: Mr. G. V. NASH.

Mr. Nash exhibited living plants and herbarium specimens illustrating the four segregates now recognized by orchidologists, and formally considered as parts of the genus *Cypripedium*. These segregates are *Cypripedium, Selenipedium, Paphiopedilum* and *Phragmipedium*. These divide themselves into two groups. In the first group are *Cypripedium* and *Selenipedium*, characterized by the usually long, leafy stem and broad, flat, thin, many-nerved leaves which are convolute in venation, and the withering perianth persistent on the ovary. In *Cypripedium* the ovary is one-celled, and the seeds elongate with a thin testa. This genus is of north temperate distribution, its representatives, about thirty in number, being found in North America, Europe and Asia.

The other genus of this group, *Selenipedium*, has a three-celled ovary, and the seeds nearly globose with a crustaceous testa. This is found from Panama to northern South America and is rare. It contains only three species, which are seldom seen in cultivation.

The second group is at once recognized by the conduplicate venation of its long, narrow, fleshy, strap-shaped leaves and the deciduous perianth. The flowers are borne on scapes, which are rarely somewhat leafy below. To this group belong the remaining two genera, *Paphiopedilum* and *Phragmipedium*. In the former the ovary is one-celled and the sepals imbricate in the bud. The most evident character, however, differentiating this at once from *Phragmipedium*, is in the lip which has the margin of the opening straight, not infolded. The scape is also commonly one-flowered, the exception being with more than one. There are some fifty species known in this genus, which is entirely old world, being generally distributed in tropical Asia and the Malay region.

The genus *Phragmipedium* is entirely new world, occurring in northern South America and Panama. It contains in the neighborhood of a dozen species, and is at once separated from *Paphiopedilum* by the character of the lip in which the margin of the opening is marked by a broad infolded portion. In addition to this the ovary is three-celled and the sepals valvate in the bud; the scape, moreover, bears several, sometimes many, flowers.

We have then in the new world three of the genera, two—*Phragmipedium* and *Selenipedium*—not known elsewhere, and *Cypripedium*, which it shares in distribution with the old world. The only strictly old world genus is *Paphiopedilum*.

PERCY WILSON,
Secretary

SCIENCE

A WEEKLY JOURNAL DEVOTED TO THE ADVANCEMENT OF SCIENCE, PUBLISHING THE OFFICIAL NOTICES AND PROCEEDINGS OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

FRIDAY, APRIL 23, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

A PLEA FOR A WIDER AND BETTER EXTENSION OF THE KNOWLEDGE OF SANITARY SCIENCE[1]

SANITARY science is young, or, at least, that much may be said of the science as we know it to-day, and consequently I presume it is scarcely reasonable to expect the public at large to be very well posted as to its latest discoveries and improvements. But so much depends upon an intelligent cooperation on the part of the masses of the people in the matter of the proper application of sanitary principles that every effort should be made to hasten the day when sound doctrine shall underlie each act of the community that is made in the interest of public health.

In view of the great width of the field which suggests itself, some kind of reduction will be necessary for our present purpose. Therefore, may I ask your attention to two items with which I have had more or less to do, viz., "water" and "air"?

A great deal has been accomplished in recent years in the matter of educating the public in the proper care of domestic water supplies; but much misunderstanding yet remains for removal, and old-time traditions are with us still.

Did you ever hear that a horse will drink no water that is of inferior quality? Such a statement has been made to me many a time and has been insisted upon as a fact. The fairy tale is pretty widely distributed, especially in country districts, and it is received as true, although it needs but a

[1] Founder's Day address, given at Lafayette College October 21, 1908.

little observation of the habits of horses to establish its fallacy. Would you, as intelligent people, who have watched horses upon occasion, care to pin your faith upon the "horse-test" as indicating the purity of your household drinking water?

When I was a boy the belief existed that the presence of many flies tended towards a healthful summer, because they were held to be the means of removal of much waste material which would otherwise decay and taint the atmosphere. We now know that flies are a source of danger in that they do not wipe their feet before crawling over our food. In this connection note the disastrous typhoid fever outbreaks in our military camps during the Spanish war. Those epidemics were occasioned by the inoculation of food by flies; flies that visited the latrines first and the kitchens afterwards.

Returning now to the water question, the time-honored dictum that a clear, bright water is of necessity a wholesome one is also still widely trusted; but it reminds me of the ruling of a Mississippi chancellor in a case with which I was once connected. His honor threw all the expert testimony out of court with the remark that the ordinary citizen is able well enough to tell whether or not a given water is fit to drink. To illustrate how far the court fell short of the truth in this instance, let me say that not long ago the clear and bright effluent from the Saratoga sewage septic tank was placed in a show window in western New York alongside of an exhibit of the local water supply, to the apparent disadvantage of the latter. Poor as the town water was, it could scarcely have been fair to compare it with filtered sewage and yet his honor from Mississippi would have judged otherwise.

The "test of experience" is constantly appealed to in support of the alleged purity of some favorite water, and the plea that "my family has used the supply for half a century" is considered an argument beyond danger of refutation, it being overlooked that a family, or even several families, can not furnish a sufficient number of persons to make the "experience test" valuable; for, be it remembered, a water known to be dangerously polluted will not transmit disease to all, nor nearly all, of those who drink it. As a matter of fact, when one considers the question from a numerical standpoint, basing his investigation upon the population of a large community, the conclusion is forced upon him that the per capita danger from polluted water is really small. Thus, in a city of 100,000 inhabitants, which I have in mind, the high typhoid death rate, manifestly caused by bad water, was about 90 per year; which means that over 99,000 of the people did not have the disease at all.

Now how about this great majority of the citizens that escaped. They would not be likely to testify as to the dangers of the water supply. As you see, the risk is small and it takes a large community to make data about it valuable, but relatively small though it be, it nevertheless is a good investment for a city to avoid it, because human life has a money value and the town which cuts its typhoid rate in half by the erection of a filter plant receives very quick return for the funds expended.

Doubtless one reason why so many people deny the existence of danger lurking in some specific drinking water is because of the non-dramatic character of the attack.

Let us suppose that a city has a yearly typhoid death rate of 75, which means that 750 people per 100,000 inhabitants have the disease each year and that 75 of them die. The impression upon the community is not really felt except by those whose homes are invaded and the remainder of the population would be likely to resort to

the old story "we have used the water for years without harm, etc." What do you think would happen in such a city if some trolley road were so badly managed as to kill 75 people every year and injure 675 others? Do you fancy it would be long before there would be mob demonstration against such a road? Or again, suppose a foreign warship should drop shells into the streets of such a town, killing from one to two people weekly and wounding nine times as many; would the people who had been hit be likely to listen with patience to such of their neighbors as claimed that because they had not been struck they doubted if there were any war vessel in the river after all?

Let us glance for a moment at the question of atmospheric air.

We all breathe, but we have been doing it so long and for the most part so easily, that a great many of us forget that we do it at all. We also eat, but the occasions for eating produce an impression upon us. Moreover, we are to a large degree particular as to the quality of the things we eat. Fancy trying to induce your employees to accept improper and tainted food. Such an effort would very probably and properly breed a riot, and yet those same people will sleep in badly overcrowded rooms and will likely complain of drafts if the windows be open. Without food they could live a week and more, while with no air they could not survive five minutes, yet one hears but rarely any comment upon the quality of that necessity of life which is so vastly more important than food.

It doubtless would be a surprising statement to preach very widely, but the cold fact remains that bad air is responsible for more deaths than alcohol. Much as we deplore the evil effects of strong drink, its victims, both innocent and guilty, are few compared with those of the "great white plague." Are you aware that practically ten per cent. of all those who died in the state of New York during the past year died of consumption, a disease which is closely connected with polluted air? Please remember those figures, one in every ten.

This has been termed "the age of hygiene" and I think the expression a good one. Much hygienic advancement has been accomplished, but a great deal more remains to be secured. Perhaps as noteworthy an instance of improvement as can be quoted is the smaller amount of spitting one sees in the street cars. That is a most encouraging fact, but why should not ventilation of the cars be insisted upon also. Given a crowded car upon a misty evening in January when the workers are returning home with garments soiled and wet, if the ventilators be closed, as they commonly are, the air within is utterly unfit for breathing. If the two halves of the car roof were hinged upon a sort of ridge pole and occasionally thrown open for a short time, much improvement in the air would result and that too without complaint, because the public will accept a great inrush of cold air for a moment when they would object to a small stream of continuous flow.

As already said, much has been done, but the question is often asked, is there any substantial benefit to show for it? Are we really better off than our forefathers because we possess these so-called improvements?

There is but one answer to such a question and that is to ask the inquirer to consult the recorded death rates and to note that the total rate for London has fallen 75 per cent. in less than 300 years; that consumption in the English army has lessened since an increased air space has been provided in barracks; that small-pox is now practically unknown in the German army, because of compulsory vaccination; and that typhoid fever has been reduced in

some municipalities as much as 70 per cent. by the introduction of filtered water.

It being a fact beyond doubt that good sanitary knowledge is a real asset of a community, the question is in order, how are we to secure a better general understanding of sanitary principles? How are the people, particularly the poorer people, to be educated along such lines?

Of all members of a community, the physicians are the ones towards whom we most quickly look for instruction in matters sanitary. Their profession primarily, of course, deals with the combating of maladies already in evidence, but they have also an undoubted duty to perform in protecting men from disease as well as in curing them of it. That being granted, it is pertinent to inquire if the medical schools provide such instruction as will place their graduates in a position to properly meet their double responsibility. So far as I can discover, such a question must too often be answered in the negative. It is expected of a physician that he should speak ex-cathedra upon topics dealing with the protection of health, but, aside from some noteworthy exceptions, the average doctor has, through no fault of his own, been unprovided with very strong foundations in sanitary science.

Let us now look at another group of men with responsibilities.

Whenever human beings are gathered together in organized bodies, as during military service, those in control of them have the serious task of safeguarding their health and it goes without saying that such persons should be equal to performing the duties of their office. Of the amount of knowledge of a sanitary kind possessed by officers of the regular army I can not speak, although my belief is that those of the medical staff, at any rate, are well-posted men. All of us must surely allow no small measure of praise to the officers of the Japanese army in view of the excellent results secured by them during the Russian war.

What can be said, however, of the expert knowledge of our officers of militia? Simply nothing. As a class, they have no proper understanding of the sanitary needs of large groups of men and yet they have been and may be again suddenly called upon to command bodies of troops in the field. Of course the line officers have those of the medical staff to lean upon, but even so, an ignorant line commander can not be educated while on the march and he can readily place his men amid such unsanitary surroundings as will produce evils exceeding the power of his medical adviser to rectify. We all know the general method followed for the selection of militia officers and are aware that popularity, coupled with a knowledge of tactics, constitutes the total requirement for election. An examination has to be passed before a commission is secured, but in that examination the questions touching upon the sanitary care of troops are few indeed. Imagine a detachment of state soldiers suddenly deprived of meat food. Is it likely that many of their line officers would be capable of suggesting a vegetable high in nitrogen to replace it?

I contend that those who are responsible for the safety of enlisted men should be as well qualified to protect them from an invasion of disease as from the bullets of the enemy. For it has been well said that if we could eliminate disease from army life, then war would become an international pastime somewhat less dangerous per capita per hour for those engaged than college football. And further, not only should the officers be posted in matters sanitary, but the men themselves should receive some sort of instruction calculated to increase their safety, efficiency and comfort.

As akin to what we have said, our thoughts now turn to another group of responsible leaders who are placed in control of bodies of very ignorant laborers. I refer to our civil engineers. Such men have a double responsibility, for it is their duty not only to protect the health of their employees, but they are also bound to guard against the very real danger of contamination reaching some neighboring town's water supply by reason of the laborers camping upon the watershed. Many an epidemic has been traced to that source of pollution.

The curricula of our engineering schools are not destitute of instruction in sanitary science, but the time devoted to it is distinctly small.

Let us change the point of view for a moment and ask how much of this kind of information is possessed by our graduate trained nurses. With what confidence could you depend upon their knowledge of the dangers lurking in water or milk and the best way to guard against them? Are they as posted as they should be upon the longevity of the more common disease germs and do they know why corrosive sublimate is not uniformly a good disinfectant for tuberculosis sputum? The answer is evident, but the blame is not with them. It lies with those who mapped out their line of training.

As a final group for our consideration let us turn towards the children in our schools and the students in some of our non-technical colleges. Are they receiving the amount and particularly the kind of sanitary instruction fitted to their future needs as intelligent citizens? Please note that I dwell upon the quality as well as upon the quantity of teaching they receive. If they be taught to clean the outside only of the cup and the platter; if they be so misled as to confound a deodorizer with a disinfectant; if they be induced to believe that straining off that which is apparent to the eye will render a polluted water safely potable, then I claim that their little knowledge is a very dangerous thing and distinctly worse than none at all.

Of all the people in the nation, the ones from whom we expect the greatest returns for our efforts in sanitary instruction are those who are sufficiently young to approach the subject with no previous prejudices. One of England's greatest surgeons, now a few years dead, was a strong opponent of the germ theory of pus formation. He expressed himself as willing to dress his patients' wounds with such bacteria if he could but get enough of them for the purpose. Men so set in their ways do not easily respond to any form of conversion. It is with those who are now young that we must lodge our hope and it is among them that we should push our sanitary propaganda, but let us advance it evenly and by first-class instructors.

A word as to what I mean by such terms.

An immense amount of effort has been expended in the cause of temperance and excellent results have been secured, but let me ask, has any similar crusade been pushed with equal vigor against the spread of other forms of intoxication; that, for instance, produced by the toxin of bacillus typhosus or the still more serious bacillus of tuberculosis? Have you any idea of the relative numbers of victims claimed by alcohol, typhoid fever and consumption each year? The effects of alcoholism are more dramatic and more disgusting and therefore more quickly command our attention, but as to the question of annual fatality and suffering produced, it is the least evil of the three.

	Deaths in State of New York, 1907
From alcoholism	1,023
From typhoid fever	1,688
From consumption	14,408

When a man drinks alcohol the object lesson for the onlooker comes speedily and it is easy for the reformer to enlist his sympathy in a temperance movement. But when one breathes in foul air loaded with the bacilli of tuberculosis no immediate results are observed and the opportunity does not present itself of closely connecting the inoculation with the subsequent development of the disease.

Please do not misunderstand me. I am very far indeed from wishing to in any way lessen the temperance movement, but I can not help feeling that the plan of campaign of that movement might very properly be studied, and possibly applied, for the arrest of the other two disorders mentioned above.[1]

Education is what is needed, not only for the purpose of coping with alcoholism, but with a view of attacking the other ills as well. You are aware, doubtless, that the temperance reformers have advanced their cause until it is a strong factor in matters political, and that they have secured the passage of laws ordering that public instruction be given as to the dangers incident to the use of alcohol. Have you ever heard of so considerable a movement being inaugurated to check the ravages of consumption or typhoid fever? Earnest efforts are now afoot to do something in that line and a good deal has been really accomplished, but those engaged in the work by no means exhibit the broad front and army-like march of the temperance organization. The people as a whole are not sufficiently educated as yet to appreciate the necessity of decided action and their sympathy with the needed reform is not awakened.

May I digress a moment and venture a word as to the wave of interest in the care and cure of consumption as we now see it in northern New York?

In the city from which I come we are plentifully supplied with committees of devoted men and women who contribute of their own means and ask pecuniary aid from others, giving meanwhile much of their time and energy for the purpose of relieving the wants and lessening the sufferings of their consumptive neighbors. The cause is such a noble one and the movement is so single-hearted that I feel badly indeed to predict its failure. Yet I believe that it must fail and for this reason. Successful handling of the consumptive poor must be the duty of public officers backed by the public purse. Funds raised by subscription and applied by voluntary workers can not grapple with the situation, because of the practically chronic character of the disease. If the community were invaded by cholera, yellow fever or the black death, and if the dead were being removed in furniture vans, as they were at Messina in 1887, then the "contribution-volunteer system" would work to perfection, because the people will always labor enthusiastically and make any amount of sacrifice to resist an attack which is quick, sharp and decisive; but if the service required be continuous, the same ten or twenty years hence as it is to-day, then the interest begins to weaken after a time, the treasury becomes empty and the movement slackens. There is just one place whence the funds for the care of the consumptive poor should come, and that is the tax budget. Is not this a plea for the education, not only of the officials who make up the budget, but also of those who vote them into office?

[1] My reason for selecting alcoholism for comparison is because of the excellent organization of those who oppose it, an organization worthy of being copied for more general use. It should be noted, moreover, that I have treated alcoholism as a disease and have touched upon its death rate only. It is scarcely necessary to add that the moral side, which is of such great importance in this affliction, does not enter the figures as given.

And finally a word as to the second point I mentioned some lines back.

Our young people should get their sanitary instruction from thoroughly competent sources, or they would do better to have none at all, because false teaching is dangerous. Books are often much out of date and it is always better to rely upon the freshly accumulated experience of those who are in touch with the active problems of the day. Even though the hours must be few during which the student is in contact with some one who is master of his specialty, yet the benefit derived greatly surpasses that obtained during a longer period of second-hand teaching.

There is no branch of instruction that lends itself more readily to what has been termed the "alumni lecture course" than does that of sanitary science.

Subsequent to the lecture a thorough quiz could be readily carried on by a person detailed for that purpose, but it should be based upon the points developed by the lecture and the latter should be given by a man who is thoroughly competent and actively engaged in his profession.

W. P. Mason

THE FUTURE OF AGRICULTURAL CHEMISTRY[1]

It may seem uncalled for at a time when agricultural chemistry has been undergoing such rapid evolution and expansion in the United States, to enter upon a discussion of its future. It is, nevertheless, true that conditions are now developing in this and other countries and have reached their culmination in Germany, which make a discussion of this subject not only desirable and timely, but practically imperative.

There is no time when it is so important to bring out correct views as to the nature of the development of an educational movement as when it is feeling some new and enormous impetus. When building progresses slowly and by stages much time is afforded for changes of plan as the work progresses, but where the progress is rapid and one stage follows another in quick succession it is of vastly greater importance that the plans shall have been fully perfected at the outset. The latter situation is certainly now before us so far as concerns agriculture and the sciences closely related thereto. The agitation for the teaching of nature study in its application to agriculture in the primary schools, the introduction of elementary agricultural instruction into the high school, the rapidly increasing demand for collegiate agricultural instruction and the imperative and almost unmet demand for university training as a proper preparation of teachers for the agricultural college and of investigators for the work of the experiment stations, have created a new and unique situation which should be met not only immediately, but most wisely. The present difficulty is not encountered solely at a single stage, but is more or less acute, as concerns the school, college and university. It is therefore of vital importance to recognize the first and most pressing need in order that by meeting it the whole situation may be relieved most quickly and satisfactorily.

The teacher of nature study in the elementary school would naturally be trained in the high school or normal school, but in this line of instruction these schools are lacking; hence there is now coming a demand upon the agricultural college to supply such teachers. The necessity under these conditions for sound instruction in the agricultural college and for men with thorough university training to teach in them, is greater than ever before.

[1] Address of the chairman of the Section of Agricultural and Food Chemistry, delivered at the Baltimore meeting of the association.

This new demand, supplementing that for men to conduct agricultural research in the experiment stations, is creating, in turn, a demand upon the university which is to-day met only in an utterly inadequate degree; and which has forced the Association of American Agricultural Colleges and Experiment Stations to provide in a slight measure for the need, by the establishment of a short, itinerary, periodic graduate school of agriculture. It is obvious that one can no more lift himself by his boot-straps than that this entire situation can be met satisfactorily without an immediate, adequate and wisely planned agricultural educational movement emanating from the university. It must give inspiration to the college, the college to the high school and normal school, and these in turn to the elementary school teacher.

The national government is now lending its aid to collegiate training in agriculture and to agricultural research, but no adequate step has been or is now being taken in the United States to provide the funds for adequately meeting this new demand upon the university. The recent organization of the Graduate School of Applied Science at Harvard University is in line with a gradually growing movement in a number of agricultural colleges and universities.

Private munificence has been wisely lavished to provide university training in theology, medicine, pure science and law, but as regards agriculture the situation is that of neglect. It is indeed surprising that the great basic industry upon which all others depend, which would seemingly be one of the first to receive support, has been almost utterly ignored, neglected or forgotten by our wealthy philanthropists. There are also certain great agricultural research problems like respiration calorimeter studies which are so complex in their nature, so exacting as to expense and the period of years necessary in which to reach definite results, that the experiment stations can at present hardly grapple with them, and still meet the other urgent demands which are made upon them; hence it is hoped that for such work satisfactory, permanent provision may soon be made. In this regard absolutely abstract research has been placed, through private munificence, on a far better plane. In fact this country now needs and awaits the advent of men who feel that these great problems, which by their final solution give promise of direct or indirect aid to agriculture, are also worthy of endowed support; and especially that provision for high-grade university training, in its application to agriculture, and of a pension system for experiment station research workers by which they may be placed on a par with the teachers, would be among the most fundamental, far-reaching and humanitarian projects for endowment.

Sufficient has been said to emphasize the great extent of the present movement for agricultural education and to show that somehow and from somewhere must come far greater support of highly complex agricultural research and especially of agricultural training of a university grade. Indeed, the movement from below is so general, so impulsive, and so powerful, that the situation from the standpoint of the university can not be much longer overlooked. It becomes important, therefore, to consider the place of agricultural chemistry in the university plan. In this connection it is of historic interest to recall that the American student who looked over the field of agricultural chemistry in this country twenty years ago could learn of but five or six teachers of this subject, most of whom were giving only collegiate courses of instruction which were often only partially commensurate with the university courses then offered in Germany. Indeed

it is a noteworthy fact that one of these men (Goessmann) is a German, while among the others were Atwater, Storer, Caldwell and Johnson, who had all derived their inspiration from study at German universities. Thus this country owes a debt of gratitude to Germany which may not be sufficiently appreciated; and notwithstanding the splendid agricultural chemical work done in France, England and elsewhere, Germany has long been looked upon as the mecca for the agricultural chemists of the entire world.

Such having been the case, the situation to-day is of particular interest in view of the attitude of Dr. H. Thiel, of the German Ministry of Agriculture, who at the International Congress of Agriculture at Vienna in 1907 presented and supported a scheme of agricultural education which shall entirely eliminate agricultural chemistry as such, which he designates as a "bastard" of various sciences, a subject essentially dragged in to fill a temporary gap. The effect of such powerful influence is already becoming strikingly evident in Germany, where the professorship of agricultural chemistry in certain cases, as in Göttingen and Halle, has been reduced in grade. Two other universities, Giessen and Kiel, now offer no facilities for the study of the subject under specialists. In Leipsic agricultural chemistry, formerly represented by men like Knop and Stohmann, has now been entirely banished. In certain universities the professors of agricultural chemistry are now given no seat nor vote in the faculties and no less prominent a teacher than the late Dr. Emmerling, of Kiel, was never promoted beyond the grade of "Privatdozent," and even this position has now become vacant. Fortunately at the agricultural "Hochschulen" and "Akademien" the situation is not yet so grave. Nevertheless, Professor Pfeiffer, to whose presentation of the subject I am indebted for the foregoing facts, states that to the best of his knowledge there is not now a single "Privatdozent" in the subject of agricultural chemistry in the entire German empire, from which it would appear that in a few years, if the present policy of Director Thiel is upheld, the student of agricultural chemistry will certainly no longer look to Germany for instruction and inspiration. This view-point of Thiel's appears to be analogous to that of a former president of a purely agricultural college in the United States, who held that when botany, chemistry, physiology, geology, mineralogy, zoology, etc., had been taught, agriculture, essentially a "bastard" of these sciences, had already been taught, and hence agriculture should be utterly eliminated from the curriculum of the agricultural college. Indeed, it is hard to see, if this logic is correct, why chemists should be trained especially in the chemistry of dye-stuffs and dyeing, or indeed in any particular department of chemistry. This same view relative to agricultural chemistry appears to be held by the dean of the college of agriculture and mechanic arts of at least one large university in this country. An even more dangerous and insidious assault upon the field of agricultural chemistry is the encroachment, in the United States, of the field of agronomy, which is becoming more and more apparent with the establishment of independent chemical laboratories in such departments.

"To be, or not to be, that is the question!" Surely if agricultural chemistry has filled its little niche temporarily and has now become superfluous and useless it should be cast adrift without delay; but on the other hand it is well to consider if this is the case. No one will probably dispute that a reasonable familiarity with the whole field of organic, inorganic and physical chemistry should be prerequisite to a course in agricultural chemistry, as well as

in any other special field of technical chemistry, and that a well-trained agricultural chemist should have had fundamental training in physiological botany, physics, geology, mineralogy, general biology and other sciences. This is obvious since the investigator in agricultural chemistry is likely at any moment to be in need of the special knowledge which may be afforded him through other sciences. He may even find it desirable or necessary to associate with himself a specially trained physical chemist, bacteriologist or physiological botanist in the solution of a problem which, approached by a man trained only in any one of those lines, would be as incapable of solution as by him. If for such a cause agricultural chemistry is to be called a "bastard" science and should be eliminated from the university these other sciences deserve it equally. Instances are by no means rare where subjects have been studied from the view-point of a given science and even indeed from that side which would have been considered unquestionably the easiest and most promising line of approach, and yet it has remained for some other man approaching the subject from the point of view afforded by a remotely related science to reach the final solution of the problem. These thoughts lead to the question: Can we afford to lose the view-point afforded by agricultural chemistry, and is not the fundamental fault with it, if such fault exists, that its field has grown to be too wide? In other words, it seems probable that not less, but more, agricultural chemistry is needed in the university and in more concentrated form. In fact, a complaint was made to the writer ten years ago by one of the leading thinkers and workers in this line in Germany, that the field was already so broad, the demands so great, and the literature so voluminous, that it was becoming a mistaken policy in Germany to oblige a professor to cover the whole subject.

In fact, that department of agricultural chemistry which deals with animal nutrition offers by itself a sufficiently wide scope in the special chemistry of the carbohydrates, fats, proteins, gums, resins, enzymes and metabolism, involving as it does so much of the field of the physiological chemist. Presumably, from the position taken by Thiel a study of nutrition from the standpoint of the physiological chemist would be considered sufficient to meet all the necessities of agriculture. It is nevertheless absurd and hopeless to expect the physiological chemist, who approaches his subject more from the view-point of medicine or human hygiene, than of agriculture, to pursue nutrition and metabolic studies with ruminants and other farm animals, excepting in so far as the special problem is calculated to bear upon general principles or upon certain features in their relation to man. On the other hand, it can hardly be expected that the agricultural chemist will fail to concentrate his energies upon the study of these problems very largely in their relation to the nutrition of farm animals. It is important that the subject should be studied independently even notwithstanding the close relationship of the work and the fact that each at many points may touch upon the field of the other. That such close points of contact exist is no suitable argument for discontinuing the work of one or the other, but on the contrary furnishes the strongest reason for the support of each, since by this contact each receives mutual assistance.

There would also seem to be an ample field for the specialized teacher in the line of agricultural chemical technology, for example in the manufacture of fertilizers, sugar, wood pulp, alcohol, vinegar, beer, wine and the vast number of other materials which might be enumerated. In

addition, the field of the chemistry of soils, fertilizers and plant nutrition, entirely aside from the usual scope and direction of the work of the agronomist, is amply broad for one man to cover if he becomes properly familiar with the past literature of the subject, and keeps abreast of the times in connection with the many experimental and analytical features involved. The fact that this field will lead him into touch with, or even at times to encroach upon, that of the bacteriologist, physical chemist, physiological botanist or agronomist, furnishes no ground for the abolishment or restriction of one or the other, but rather emphasizes the importance of maintaining these different points of view, since they are likely at any time to furnish a special vantage ground, or new avenue for the attack upon some difficult problem, which, approached from any other direction, might not admit of solution.

The most hopeful feature connected with the teaching of agriculture in the United States at the present moment is the rapid rate at which the subject is being divided into specialties, for it is only in this way that it can ever be hoped that its students can acquire the best knowledge of the theory and practise in any given line, and no alarm need be felt if these subjects have a close "touch of elbows." When a teacher covers too large a field he is sure to be weak in his knowledge of either the theory or practise and a condition thus arises which interferes with science taking its true place in its relation to the advance of the practise of agriculture in its several departments. Indeed there is little ground for wonderment that the classically educated man who saw, a few years since, a single "professor of agriculture" struggling to cover superficially the whole of his broad field, with little if any of his subject-matter reduced to pedagogic form, should not have been moved to feel that he was merely placing a cheap and useless veneer over the other sciences. If agricultural chemistry is today in a somewhat similar position then surely the time has come when, instead of its being thrown overboard because of its breadth, it should, like general agriculture, be properly subdivided and given the fullest opportunity for its development. It may be claimed that agricultural chemistry covers partially the same field as agronomy and hence should be eliminated; but the attempt to place such artificial barriers between the different sciences and to provide that one shall not encroach upon the field of the other prevents the greatest progress and interferes with the organization of effective and sound research. The need in such cases is provision for sympathetic and hearty cooperation. Indeed, the erection of such barriers is no less pernicious than the elimination of view-point which would come from the pursuit of pure science by itself, in the university, unaccompanied by any attempt to study and teach its application, since each furnishes a stimulus to the other. The additional point of view of the professor of applied science is too valuable to the university to be lost. It is not only vital to the welfare of agriculture and to most of our great industrial undertakings, but is helpful and even inspiring to those pursuing pure science as such.

Apparently the result of the present general movement as represented by Thiel is to remove the higher teaching and research in science as related to agriculture, entirely or largely from the universities and to concentrate it in connection with purely agricultural institutions, such for example as "Landwirtschaftliche Hochschulen." If such a general policy were adopted in this country it would mean adding to our present agricultural colleges the highest grade of university instruction in the sciences related to agriculture, rather than adding

such instruction to the university, where it could be the handmaid of pure science in its highest aspect. It is indeed possible that the former course may yet be followed in this country in consequence of the attitude of the university toward applied science, but if so, it would seem to be in consequence of following the lines of least resistance instead of adopting the wisest, broadest and most effective policy. It would seem that a divorce of science as applied to the great industry of agriculture, from the close and intimate touch with the highest and best in pure science, and from the finest academic atmosphere which the country can supply, would be an equally great misfortune to science in both its pure and applied form. In this connection, it is of the utmost importance that the college and university teacher of science, in its relation to agriculture, as well as men in training for research positions in the agricultural experiment stations, should have approached the university through an agricultural college of as high standing educationally as other institutions of collegiate grade, and that they shall not enter this university field without the close touch with agriculture and with the allied sciences which such agricultural colleges afford, since this is essential to their highest usefulness.

That which is most needed at the present time is to provide university education from the view-point of agriculture, and this ought to have immediate and splendid support.

At a time when agricultural chemistry is "under fire" it is especially fitting to consider its requirements and to judge it by its fruits. The very nature of the subject brings the teacher of agricultural chemistry in the college, and the experiment station investigator in close touch with the farmer and hence a knowledge of practical matters is indispensable to his highest success and usefulness, a requirement which has forced from the ranks some of the general chemists who have tried to enter the field of agricultural chemistry. The conditions imposed have made the field a particularly favorable one for the young man who has been reared on the farm, who has had an agricultural college education and who is thus in position not only to give the farmer the advice and counsel which he seeks, but also to be governed by sound judgment in his scientific deductions in their bearing upon agricultural matters. The very fact that a more or less general knowledge of several sciences, and thorough training in general chemistry are required, has forced the student in this line to prepare himself more fully for his work in the past, than in many of the other sciences related to agriculture. These combined features furnish a splendid preparation for the administrative duties devolving upon the director of an agricultural experiment station. In fact it is doubtless due to these considerations that a great proportion of the agricultural experiment station directors in this country and in Europe have been chosen from the ranks of the agricultural chemists. Thus this science has yielded special fruit by way of leaders in agricultural investigation in addition to its vast number of other contributions to our general agricultural progress.

It is needless to cite what the agricultural chemist, from the time of Liebig to that of Hellriegel, has contributed to agriculture; since the men and their work are too well known and appreciated to require enumeration. It can not be disputed that without the aid of agricultural chemistry modern agricultural progress would have been impossible and the world would now be crying for food. Indeed, even a casual survey of the fruits of agricultural chemistry and of its benefactions to the people justify not only its past existence, but for

the future far greater and more general recognition in the universities, where it should receive at once magnificent support and endowment. Now is the time for us to seize upon this inheritance which Germany seems about to relinquish!

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SCIENTIFIC NOTES AND NEWS

The two volumes containing "The Collected Papers of Joseph, Baron Lister," will shortly be issued from the Clarendon Press. They were planned as a memorial of Lord Lister's eightieth birthday, celebrated two years ago. The committee formed for the purpose has had the advantage of Lord Lister's advice, and the two volumes contain all the papers and addresses which he considers to possess permanent value.

Professor H. F. Osborn, of Columbia University, has recently been elected one of the twenty-five foreign members of the Zoological Society of London, and also an honorary member of the Royal Academy of Sweden, as the successor of the late Professor Albert Gaudry.

Prince Albert of Monaco has been elected a foreign member of the Paris Academy of Sciences in succession to Lord Kelvin.

Edinburgh University has conferred the honorary degree of LL.D. on Mr. J. G. Bartholomew, hon. secretary Royal Scottish Geographical Society; Professor A. Crum Brown, F.R.S.; Professor W. Burnside, F. R.S., Royal Naval College, Greenwich; Sir Alfred Keogh, K.C.B., director-general of the Army Medical Service, and Professor C. H. Kronecker, University of Berne.

Sir Richard D. Powell has been reelected president of the Royal College of Physicians of London.

Dr. Clemens von Pirquet, of Vienna, has been appointed physician-in-chief to the Harriet Lane Home for Invalid Children, affiliated with the Johns Hopkins Hospital and professor of pediatrics in the university.

Dr. Oliver L. Fassig, of the U. S. Weather Bureau, Baltimore, and the Johns Hopkins University, has been placed in charge of the Porto Rican station with headquarters at San Juan.

Professor H. E. Gregory, of the geological department of Yale University, will, on behalf of the U. S. government, undertake an expedition to the Arizona desert to seek a water supply for the Navajo Indians living on the Arizona reserve.

The annual business meeting of the Phi Beta Kappa Alumni in New York will be held in the Hotel Savoy on the evening of May 4, when Dr. Simon Flexner, director of the Laboratories of the Rockefeller Institute for Medical Research, will address the association on the subject "The Service to Medical Science of Independent Institutions for Medical Research."

Professor Joseph Barrell, of Yale University, gave a series of lectures in the department of geology at the University of Wisconsin from March 31 to April 6, dealing especially with sedimentation in some of its more modern aspects.

At the 353d regular meeting of the Middletown Scientific Association, held in the Scott Laboratory of Physics, Wesleyan University, on April 13, Dr. Arthur Eugene Watson, assistant professor of physics in Brown University, gave an illustrated lecture on "Some Mile-stone Marks in Electrical Engineering."

A meeting of instructors and advanced students at Harvard University for the discussion of a recent chemical research will be held in Boylston Hall at 5 o'clock on the following Thursdays: April 29, May 6, 13, 20 and 27, and June 3. The next meeting will be open to all members of the university, and the special subject will be "The Rusting of Iron," by Dr. Allerton S. Cushman, of the U. S. Department of Agriculture.

Under the auspices of the department of physics of Columbia University a course of lectures on "The Present State of the System of Theoretical Physics," will be given by Max Planck, Ph.D., professor of mathematical

physics in the University of Berlin, lecturer in mathematical physics in Columbia University, 1908–1909. The lectures will be given in German on Friday afternoons at 4:10, and Saturday mornings at 10:10 from April 23 to May 15.

April 23 and 24—Introduction. "Reversibility and Irreversibility."

April 30 and May 1—"Kinetic Theory of Matter."

May 7 and 8—"Radiation of Heat."

May 14 and 15—"General Dynamics. The Relativity Principle."

Frank Leo Tufts, B.S. (Antioch, '91), A.B. (Harvard, '94), Ph.D. (Columbia, '96), adjunct professor of physics in Columbia University and the author of valuable contributions to experimental physics, was killed by an electric shock, on April 15. He was born in Findlay, Ohio, in 1871.

Dr. W. H. Edwards, known for his work on the butterflies of North America, died at Coalburo, West Virginia, on April 4, at the age of eighty-eight.

The death is also announced of the Rev. Dr. Sereno E. Bishop, who had spent more than fifty years as an American missionary in the Hawaiian Islands and had made contributions to our knowledge of their volcanoes.

There will be a New York State civil service examination on May 1 for the position of assistant bacteriologist in the State Department of Health at a salary of $1,500.

A North Dakota Academy of Science has been organized and will hold a spring meeting at Grand Forks on May 21. At this meeting Professor M. A. Brannon will outline the work that is before the academy in the biological sciences; Dr. Geo. Stewart that in the physical sciences, and Professor D. E. Willard that in geology. The first two named are in the State University at Grand Forks and the last is in the Agricultural College at Fargo. The president of the academy is Professor H. A. Brannon, of the State University, and the secretary is L. B. McMullen, of the State Normal School.

Plans for the Pacific Coast meeting of the American Institute of Mining Engineers provide for a visit to Yellowstone Park, September 25 to 30; Spokane, October 2 to 6; Seattle, October 8 to 11; Tacoma, October 12, and Salt Lake City, October 15 to 19. The special train is to leave New York, September 22, and return just a month later.

The semi-annual meeting of the American Institute of Chemical Engineers will be held on June 24 and 25 at the Polytechnic Institute, Brooklyn, N. Y. The program will consist of papers, excursions and an exhibit of chemical engineering apparatus.

A conference on public health is being held this week at the University of Illinois under the auspices of the university and the Illinois State Board of Health. Professor W. T. Sedgwick, of the Massachusetts Institute of Technology, will deliver a series of lectures on the general subject, "Science in the Service of Public Health." Dr. T. J. Bryan, chemist of the Illinois State Food Commission, will speak on "The Relation of Pure Food to Public Health." A special session of health officers will be held on April 23, for general discussion of problems of health in the state. Dr. Egan, secretary of the State Board of Health, will open this session.

Dr. F. Creighton Wellman, who has had long experience as health officer in Portuguese East Africa, gave a series of extensive lectures under the auspices of the medical department of Tulane University on the following dates and subjects:

April 12—"Insects and Human Diseases."

April 13—"Diseases of West Africa."

April 14—"A Naturalist in West Africa."

April 15—"Why the Physician in Temperate Climates should study Tropical Diseases."

April 16—"General Biological Conditions in West Africa."

April 17—"Anthropological Notes made in West Africa."

A course of eight free popular lectures was given at the Chicago Academy of Sciences on Friday evenings during February, March and April, as follows:

February 19—"The Volcano of Kilauea," by Mr. William A. Bryan, president, The Pacific Scientific Institution.

February 26—"The Deserts of Arizona," by

Dr. Henry C. Cowles, assistant professor of ecology, University of Chicago.

March 5—"Studies in Geology: The Grand Canyon of the Colorado River," by Dr. Wallace W. Atwood, secretary of the academy.

March 12—"Studies in Geology: The High Mountains of North America," by Dr. Wallace W. Atwood, secretary of the academy.

March 19—To be announced.

March 26—"The Conservation of our Natural Resources," by Mrs. Jane Perry Cook, head of department of geography, Chicago Normal School.

April 2—"Studies in Geology: The Geological History of the Chicago Region," by Dr. Wallace W. Atwood, secretary of the academy.

April 9—"Travel and Exploration in Alaska," by Dr. Wallace W. Atwood, secretary of the academy.

The Geographic Society of Chicago has arranged for the month of May two excursions, the regular excursion on the second Saturday of the month and a special one later in the month. The regular excursion will take place on Saturday, May 15, under the leadership of Dr. Otis W. Caldwell, of the University of Chicago. The region visited will include the rich woods and the remarkable moving dunes near Furnessville, Indiana. The special excursion for May will be to Starved Rock and the Canyons of the Illinois River. Specialists will give the history of the region, explain its topography, and interpret its flora and avifauna. The society is actively supporting a measure now before the legislature looking to the incorporation and preservation of Starved Rock and its environs within the confines of a State Park.

We learn from *Nature* that the Royal Physical Society of Edinburgh has opened its doors to women members. At the March meeting of the society, Mrs. Elizabeth Gray, Edinburgh; Miss Marion I. Newbigin, D.Sc., Edinburgh; Mrs. Ogilvie Gordon, D.Sc., Ph.D., Aberdeen, and Miss Muriel Robertson, London, were elected ordinary fellows.

The U. S. Geological Survey has just opened at Denver a permanent branch office to facilitate the transaction of its western work, thus providing a base of supplies for the large corps of engineers who are kept in the field many months each year, making geologic studies of mineral deposits, conducting detailed topographic surveys for the base maps of the geologic atlas of the United States, mapping the great national forests, investigating surface and underground waters, and collecting statistics of mineral production. The establishment of such a branch office is not only intended to serve the convenience of the survey corps, but it is designed also to meet the great need of the western public for a source of information less remote than Washington. A supply of copies of the publications available for free distribution will be kept on hand, as well as a complete file of the topographic maps, geologic folios, and other publications of the survey subject to sale. All of these publications will be open to inspection by persons desiring information concerning the subjects treated. Prospective purchasers of maps and folios will be referred to the nearest sales agent, and the free publications will be distributed in Denver to those making application. In short, the Denver office is intended to serve the public in all matters that lie legitimately within the province of the United States Geological Survey. The office is located in the Commonwealth Building and was opened on the first of April. R. C. Miles, special disbursing agent, is at present in charge, and will answer all inquiries, distribute documents, and maintain a visitors' register.

UNIVERSITY AND EDUCATIONAL NEWS

At the recent annual celebration of Founder's day at the University of Virginia, President Alderman announced that an endowment fund of $1,000,000 had been completed during the past year. Between November and February $750,000 of this total was secured in sums as follows: Andrew Carnegie, $500,000; Oliver H. Payne, $50,000; children of John B. Cary, $20,000; Christian Woman's Board of Missions, $30,000; Thomas F. Ryan, $25,000; Charles H. Senff, $25,000; Charles Steele, $30,000; Robert Bacon, $10,000; H. McK. Twombley, $10,000; General Education Board, $50,000. The $500,000 given by Mr. Carnegie will become the per-

manent endowment of six existing schools in the university, and these schools are to be given the names as follows: The James Madison School of Law, the James Monroe School of International Law, the James Wilson School of Political Science and Political Economy, the Edgar Allan Poe School of English, the Andrew Carnegie School of Engineering, the Walter Reed School of Pathology.

Gifts to Princeton University for the quarter ending with the spring recess aggregated $145,939. $100,000 was presented by Cleveland H. Dodge, '79, of New York, for part of the endowment of Guyot Hall, the new natural science laboratory now under construction on the eastern side of the campus. A fund of $400,000 was presented some time ago for the construction of the building, which is now nearing completion. The next largest gift came from the committee of fifty alumni who are raising funds by subscription for the immediate needs and future development of the university. This committee turned in a total of $38,039 for the quarter, $28,039 of which goes to current expenses and $10,000 for endowment.

Exercises appropriate to the opening of the new engineering building of Rutgers College, erected at a cost of $100,000, were held on April 14. The building contains seven classrooms, five laboratories, six professors' offices, and three draughting rooms. It is used by the departments of civil, electrical and mechanical engineering.

The University of Pennsylvania correspondent of the New York *Evening Post* states that the cosmopolitan character of the student body at the university was emphasized at the recent formation of the Cosmopolitan Club, the object of which is to hold occasional meetings, when an opportunity will be afforded to men of all nationalities to become acquainted with each other, and to discuss matters of common interest. It is planned to hold, next year, a series of "national nights," where the customs of each country will be presented by its representatives. It was found that there are 120 students in the university from the Latin-American countries, 50 students who are British subjects, and 31 who are Chinese. There are 32 other countries represented in the student body.

Dr. A. A. Murphree, president of the State College for Women at Tallahassee, has been elected president of the University of Florida.

Dr. R. C. Hughes has resigned the presidency of Ripon College.

J. F. Messenger, A.B. (Kansas), A.M. (Harvard), Ph.D. (Columbia), professor in the department of psychology and education of the State Normal School at Farmville, Va., has been called to the University of Vermont.

M. Dangeard, editor of the *Botaniste*, professor in the faculty of Poitiers, has been called to a chair in the faculty of sciences at Paris.

DISCUSSION AND CORRESPONDENCE

THE FUNDAMENTAL LAWS OF MATTER AND ENERGY

To the Editor of Science: In a recent number of *The Technology Quarterly* (June, 1908) appears an article by Professor Lewis entitled "A Revision of the Fundamental Laws of Matter and Energy." It closes with the following summary:

It is postulated that the energy and momentum of a beam of radiation are due to a mass moving with the velocity of light.

From the postulate alone it is shown that the mass of a body depends upon its energy content. It is, therefore, necessary to replace that axiom of the Newtonian mechanics according to which the mass of a body is independent of its velocity by one which makes the mass increase with the kinetic energy.

Retaining all the other axioms of the Newtonian mechanics and assuming the conservation of mass, energy and momentum, a new system of mechanics is constructed.

In this system momentum is mv, kinetic energy varies between $\frac{1}{2}mv^2$ at low velocities and mv^2 at the velocity of light, while the mass of a body is a function of the velocity and becomes infinite at the velocity of light. The equation obtained agrees with the experiments of Kaufmann on the relation

between the mass of an electron and its velocity. It is, moreover, strikingly similar to the equations that have been obtained for electromagnetic mass.

The new view leads to an unusual conception of the nature of light. It offers theoretically a method of distinguishing between absolute and relative motion.

Mass is defined by Professor Lewis as momentum (M) divided by velocity (v),

$$m = M/v.$$

I should like to say a few words about this summary and the paper to which it belongs.

The notion of momentum in a beam of radiation is introduced with the aid of the "law of conservation of momentum." The other two laws required, of the three in all, are the conservation of energy and the conservation of mass.

For the sake of argument, I shall assume a beam of radiation to consist of a mass in motion and proceed to consider the use of such a hypothesis or conception.

What happens when that beam impinges on a body? That the body receives energy and that this energy is shown by the movement of the body is settled beyond doubt by experiment, but that the moving mass in the beam sticks to the body it strikes is very questionable. How can it stick to a body which radiates as much energy as it receives and of the same nature? Professor Lewis does not seem to consider this difficulty. But, for the sake of argument again, I assume that what is mass in the beam of radiation does adhere to the body it strikes. Then, of course, the mass of the body struck increases as it moves and increases as it receives this particular form of energy, but only as it receives *this particular form*. Yet Professor Lewis considers this increase of mass with energy as typical and concludes that because the mass of a body increases as it receives radiant energy, to which he assigns a very special constitution, therefore its mass increases when it receives any energy whatsoever and diminishes when it loses any energy whatsoever. Otherwise, what does the following mean:

Assuming the fundamental conservation law [of momentum? C. L. S.], we must regard mass as a real property of a body which depends upon its state and not upon its history. Hence it is obvious that if in any other way than by radiation the body gains or loses energy, it must gain or lose mass in just the above proportion [see equation (5) below, C. L. S.]. In other words, any change in a body's content of energy is accompanied by a definite change in its mass, regardless of the nature of the process which the energy change accompanies.

This seems to me equivalent to saying that all energy is of the same nature as radiant energy, a notion not acceptable in the present state of our sciences. Professor Lewis thinks that consequently one of the axioms of Newtonian mechanics must be changed. I suppose he refers to axiom 1, but none of the three says a word about this relation. They imply this independence of mass and velocity, but were they to be found dependent, I can not see that any of the three would be changed, necessarily, in wording. I do not find in this whole development anything more than a special kind of action, one that can not be generalized at all. A ship bombarded by projectiles and moving in the same direction as the projectiles continues in the same direction as before with increased mass and increased velocity due to the mass and energy of those missiles. But who would draw any general conclusions as to the nature of all the other energies from this? It is a very easily analyzed case, but I do not see how it differs in principle from the more obscure one of radiant energy.

The change in mass for a given quantity of energy is calculated by Professor Lewis thus:

The moving mass of the beam imparts dE of energy in dt time, so in t time it imparts $(dE/dt)t$ of energy. During this time t, a quantity of energy has traveled up to the body absorbing the radiation and been delivered to it equal to fs where f is the radiation pressure and s is the distance the radiation has traveled in t time. Making t equal to unity, s becomes the velocity of radiation, V. Then,

$$f = dE/Vdt. \qquad (1)$$

By condition, this f, being due to a moving

mass, imparts momentum dM in time dt and so,

$$f = dM/dt. \qquad (2)$$

With (1) and (2),

$$dE/dM = V. \qquad (3)$$

But a momentum from a mass dm moving with a velocity V requires that

$$Vdm = dM, \qquad (4)$$

and so with (3),

$$dm = dE/V^2. \qquad (5)$$

Now equation (5) is a very simple thing. It gives the mass needed at velocity V to produce the energy dE in this special way. But Professor Lewis says this equation gives the *change in mass when the energy of the body changes by dE in any manner whatsoever.* I do not see that this inference is legitimate at all.

In the fourth paragraph there is the startling statement that the mass of a moving body becomes infinite at the velocity of light. It seems to me this at once throws suspicion on the line of reasoning leading up to such a conclusion. Professor Lewis recognizes this difficulty for he says, "Therefore that which in a beam of light has mass, momentum and energy, and is traveling with the velocity of light, would have no energy, momentum or mass if it were at rest, or, indeed, if it were moving with a velocity even by the smallest fraction less than that of light," adding with great naïveté, "After this extraordinary conclusion it would at present be idle to discuss whether the same substance or thing which carries the radiation from the emitting body continues to carry it through space, or, indeed, whether there is *any substance or thing connected with the process.*" (Italics mine, C. L. S.) Moreover, I do not see how this part of the fourth paragraph is consistent with (5). There is no special value, numerically, to be assigned to V in deducing (5) and so there can not be an extraordinary jump from a finite to an infinite value when V has a certain finite value assigned it. We have no right to assume that the velocity of light is the greatest possible velocity in the universe. What would the mass become for a greater velocity? What does the mass become for the lesser velocity of light in water?

It seems to me that there is no need for any such startling conclusion. In fact, no opportunity for it, as I think will be seen from the following.

A beam of radiant energy composed of a moving mass changes the momentum of the body struck by it both by the change in velocity and by the change in mass due to the mass of the beam passing into the body struck by the beam. Hence, from the definition of momentum, $M = mv$,

$$dM = mdv + vdm. \qquad (6)$$

Replacing in (4),

$$Vdm = mdv + vdm,$$

or

$$dm/m = dv/(V - v).$$

In this equation, V is the velocity of the striking mass of the beam, the mass of which is dm, while v is the velocity of the object struck whose mass is m, and dv is the velocity imparted to it, to the mass m. Consequently, this equation expresses the relation between the change in mass of the object struck, due to the accretion from the mass of the beam, and v, the velocity of the object, due to the impact of the beam mass. Integrating,

$$m/m^0 = V/(V - v) \qquad (7)$$

where m^0 is the mass of the object at rest, that is, when v is zero. When v is V, its mass becomes infinite, which means that a mass aggregating to an infinite mass must accumulate on the object before it will attain a velocity equal to the velocity of the pelting mass of the beam. In other words, the mass of the object must become relatively zero and not absorb any of the kinetic energy of the beam for itself, to increase its motion. This is surely simple! Who would conclude from this that when a body is given a velocity equal that of light in any way whatsoever its mass becomes infinite? Yet this is what Professor Lewis seems to do. He deduces his equation in a somewhat different way, passing through the energy and not through the momentum,

but coming out with an equation of the same nature as 7. As I understand it, he proceeds as follows:

Combining (1) and (2), for any velocity,

$$dE = vdM,$$

and replacing dM from (6) and dE from (5),

$$V^2dm = vmdv + v^2dm.$$

Integrating,

$$m/m^0 = V/\sqrt{V^2 - v^2}, \qquad (8)$$

in which as before, when v is zero, m is m^0, the mass of the object at rest, and when v^2 is V^2, the mass is again equal to infinity, for the same reason as given previously. Professor Lewis interprets this equation thus: "According to equation (8), any body of finite mass increases in mass as it increases in velocity, and would possess infinite mass if it could be given the velocity of light."

Consider a body in a rarefied atmosphere and set in motion by the gas particles. It seems to me that Professor Lewis's reasoning will apply equally here, and then a body moving with the velocity of the gas particles should gain infinite mass. According to my interpretation of the equations, when the body did gain the velocity of the gas particles, an infinite number of them, an infinite mass, would have accumulated on the object.

I am inclined to think myself that these troubles of mine are due to unfortunate wording. If so, Professor Lewis ought to make the thing clearer, as it is very important, and I am sure many others have the same difficulty I have in harmonizing the article with one's experiences and reasoning powers.

Clarence L. Speyers

Cambridge, Mass.,
December 14, 1908

MARS AS THE ABODE OF LIFE[1]

Although it is improbable that these lines will be read by more than a small proportion of those who have seen or heard of Mr. Percival Lowell's "Mars as the Abode of Life," it seems worth while to point out to the scientific workers of the country the gross errors which this book is propagating. In this I shall confine myself to geological matters, leaving the astronomical and other questions to those who have special acquaintance with such things. It is not surprising that Mr. Lowell, an astronomer, should have only a layman's knowledge of geology; but that he should attempt to discuss critically the more difficult problems of that science, without, as his words show, any understanding of the great recent progress in geology, is astonishing and disastrous. One can not but recall the adage that "fools rush in where angels fear to tread."

Mr. Lowell is an implicit believer in the Laplacian theory of planetary evolution, a hypothesis now on the defensive, to say the least, and utterly abandoned by some of our best cosmogonists.

On an adjacent page he says that the minerals of the metamorphic rocks "show by their crystalline form that they cooled from a once molten state." The fallacy in this statement is evident to the average college student of geology or chemistry. Metamorphic rocks are produced by processes which involve more or less pressure and heat, but not melting.

Turning to consider the evolution of life on the earth, the author tells us that "the geologic record proves that life originated in the oceans. . . . Whether life might have generated on the land we do not know; on earth it certainly did not." The truth is that the geologic record proves nothing whatever about the origin or even the infancy of life. It may be fairly doubted whether it takes us back even to the middle age of the animal kingdom. Such a dogmatic assertion is, therefore, wholly unjustified. In this connection it is hard to resist pointing out that among the oldest known fossils are certain Eurypterids (Walcott's *Beltina danai*) which are generally interpreted as fresh-water rather than marine forms.

Farther on we read, of the plants which formed the Carboniferous coal beds, "Only a warm, humid foothold and lambent air could have given them such luxuriance and im-

[1] A series of lectures delivered before the Lowell Institute, Boston; later published in the *Century Magazine*, 1908; and subsequently issued as a volume by the Macmillan Company, New York, 1908.

pressed them with such speed." Neither Mr. Lowell nor any one else knows whether the vegetation in the Carboniferous swamps grew slowly or rapidly. We know only that they produced a certain body of coal. That may have taken a short time at a rapid rate, or a long time at the slow rate; the results would be the same. As to the warmth, it may be remarked that coal seams are now in process of growth in Alaska and Labrador and that many of the Carboniferous plants show by their structures an adaptation to severe rather than genial climatic conditions. Only a little later than the Carboniferous period most of the lands adjacent to the Indian Ocean experienced a glacial period, comparable to that of recent times in Canada; and in Australia the coal seams are interbedded with layers of glacial drift. Does this bespeak a torrid climate in middle latitudes at that time? Even the moist conditions seem to have been, as now, of local prevalence only, for aridity is indicated by the Carboniferous red beds and gypsum of Colorado and some other regions.

One of the terrestrial conditions which Mr. Lowell finds it necessary to postulate in order to bolster up his theory of Martian evolution is a perpetual cloud envelope around the earth down to about Mesozoic times—"a shady half-light" which he says is attested "by the habit of the ferns of to-day." That tree-ferns now stand out isolated on the brushy hills of equatorial Africa under the blazing tropical sun is evidently unknown to the author. Under the circumstances he would have found the services of a botanist advantageous.

With the hypothesis of a perpetually damp cloudy atmosphere we can hardly reconcile the existence of deserts in India in the Cambrian, in New York in the Silurian, in Michigan and New Brunswick in the Carboniferous, and in Germany in the Permian period. Yet the testimony of the rocks is emphatic that they did exist in those times and places.

Another of the author's preconceived opinions of Mars, which the history of our own planet has been twisted and squeezed to fit, is the shrinkage of the oceans and the eventual disappearance of water in any form. According to Mr. Lowell, Mars had oceans but lost them, and the earth is merely in an earlier stage of the same process. As to the earth, he says, "observation proves this to be a fact," and goes on to cite Professor Dana, who many years ago propounded the opinion that the lands had grown steadily larger from small beginnings. If Dana were alive to-day he would doubtless repudiate the idea, for it is wholly contrary to the mass of facts more recently made known. If Lowell were right, land on the continent of North America would have been smallest in the Archean and be greatest now. The truth is that there have been fluctuations of land and sea throughout recorded geologic history, and these changes show no general tendency. Just before the Cambrian period the continent was nearly all out of water; at the close of that period it was at least half submerged. At the close of the Permian it emerged more extensively than ever and yet in the Cretaceous it was again deeply inundated. Examples of the same thing could be largely multiplied, but are too well known to make that necessary.

In the face of all these facts Mr. Lowell coolly states that "wherever geologists have studied them, the strata tell the same tale," viz., the land has spread, the ocean shrunk.... No competent geologist would admit a word of this. Yet on this comfortable basis of fallacy Mr. Lowell then proceeds "Now, a general universal gain of the sort can mean only . . ." One is tempted to direct the author's attention to his own preface wherein he seriously admonishes that "the cogency of the conclusion hangs upon the validity of each step in the argument." The reader can judge for himself of the cogency of this particular conclusion.

Having assured his readers that the earth is drying up and that it will sooner or later "roll a parched orb through space," he cites as proof the alleged fact that deserts are increasing in size. This is the beginning of the dreadful end which "is as fatalistically sure as that to-morrow's sun will rise, unless some other catastrophe anticipate the end." Here again the proverb applies, "a little knowledge is a dangerous thing." Mr. Lowell

has seen the petrified stumps and trunks of trees in the Arizona desert and jumps to the conclusion that deserts in general have been steadily invading once forested regions, from remote ages onward. Had he inquired into the recorded facts of geologic history he would have learned that deserts have existed in many parts of the world ever since the earliest periods, wherever the topographic and atmospheric conditions were favorable. It is not probable that our present deserts are more extensive than those of the Permian period, during which the saltest of salt lakes partially covered the site of Germany.

I think enough has been said to show what kind of pseudo-science is here being foisted upon a trusting public. "Mars as the Abode of Life" is avowedly a popular exposition of a science, not a fantasy. Its author is a highly educated man of distinguished connections and some personal fame. He writes in a vivid, convincing style, with the air of authority in the premises. The average reader naturally believes him, since he can not, without special knowledge of geology and kindred sciences, discern the fallacies. He has a right to think that things asserted as established facts are true, and that things other than facts will be stated with appropriate reservation. This is precisely the same as his right to believe that the maple syrup he buys under that label is not glucose, but is genuine. The misbranding of intellectual products is just as immoral as the misbranding of the products of manufacture. Mr. Lowell can not be censured for advancing avowed theories, however fanciful they are, for it is the privilege of the scientist; nor for making unintentional mistakes in fact, for that is eminently human. But I feel sure that the majority of scientific men will feel just indignation toward one who stamps his theories as facts; says they are proven, when they have almost no supporting data; and declares that certain things are well known, which are not even admitted to consideration by those best qualified to judge. Censure can hardly be too severe upon a man who so unscrupulously deceives the educated public, merely in order to gain a certain notoriety and a brief, but undeserved, credence for his pet theories.

ELIOT BLACKWELDER
UNIVERSITY OF WISCONSIN,
March 26, 1909

SCIENTIFIC BOOKS

L'Europe Préhistorique. Principes d'Archéologie Préhistorique. By SOPHUS MÜLLER. Translation from the Danish, by EMMANUEL PHILIPOT. Paris, J. Lamarre, Editeur. 1907. Pp. 212, text-figures 161, colored plates 3.

There was a time when civilization did not exist. When did it begin to be and whence came it? Sophus Müller believes it was transplanted into Europe from the Orient. The author has endeavored to confine his work to those elements in prehistoric archeology about which authorities are in accord.

Not much space is devoted to the paleolithic period. France is taken as a center and as the region that shows to best advantage the various stages of paleolithic culture. The reindeer epoch is lacking in Italy, as one might expect, although specimens of the Solutrean and Magdalenian types are found there.

The first epoch of the neolithic period in Italy was synchronous with the last epoch of the paleolithic period in France; the culture of middle Europe being only the periphery of a civilization more advanced in the south.

According to Müller there was in central Europe only one great period of cold after the warm climate of the Chellean epoch when man appeared for the first time. The temperature dropped during the Solutrean and became very cold in the Magdalenian, to grow milder again until the present time. He also believes the paleolithic period to be much shorter than the time ascribed to it by many geologists, notably Penck.

A chapter is devoted to the changes that came with the appearance of the neolithic period in central and northern Europe, especially the differences in the fauna and the similarities among the artifacts. The importance of Piette's discoveries of a transitional industry in the cavern of Mas d'Azil

(Ariège) is noted, as well as similar finds in northern Germany, Russia and Denmark. The north was colonized at a later epoch than were western and southern Europe, Müller placing the date at about 6000 years B.C.

The appearance of the stone ax, chipped but not polished, is what marks the beginning of the neolithic period. It was in the kitchen middens of Denmark that the two principal forms of this ax were first recognized. These shell heaps seem to have been the dwelling places of the people, as numerous hearths are found in them. Here implements were made and repaired. Sherds of a coarse pottery without ornament are also found. Two types have been determined: large jars with pointed bottom, and shallow bowls. The dog was already domesticated, but had evidently been brought to the Danish peninsula from southeastern Europe. The stone axes of the kitchen midden types are found not only to the eastward as far as Russia, but also in southern England, over France, where it characterizes the so-called Campignian epoch, and in Italy. This is also the epoch of small arrow points with transverse edge.

But it would be an error to suppose that the civilization of the north and of the south had the same aspect. New elements were replacing the old in Italy long before they reached Denmark. On the other hand, the tardiness on the part of the latter country was an important factor in the splendid development of its local neolithic industry.

With the second stage of the neolithic period appeared the polished stone ax, a much better tool than its predecessor. It ushered in a period of general industrial development that continued uninterrupted for about 2,000 years. In the Balkan peninsula, Greece, Italy and Spain, none of the polished stone axes are of flint, although this material was used in the manufacture of other tools and arms. A striking example of this is afforded by the prehistoric station of Butmir near Sarajevo, Bosnia, where about six thousand axes and chisels were found and not one made of flint; although there was plenty of flint in the neighborhood and it was used in other forms. North of the Alps, on the contrary, polished flint implements occur with increasing frequency until England and Scandinavia are reached. This state of things is no doubt due to the longer duration of the neolithic period in the north and to the amount of labor required to polish flint.

The art of polishing stone implements evidently originated in the Orient, as did the other characteristic element of the later neolithic, *i. e.*, the geometric ornament on the pottery that replaced the realistic art of the paleolithic. This epoch was preeminently influenced by the domestication of animals. To the dog were added the sheep, the goat, the hog and ox. Agriculture became more and more important. Wheat, barley and millet were all cultivated and all came from the Orient, as did the domestic animals. The people became less and less nomadic in their mode of life. They lived for the most part in villages composed of huts half underground. These followed one general plan—a round or oval excavation covered by a roof of branches and reeds and strengthened by the application of clay. This type of dwelling spread over Europe as far as Scandinavia and persisted for centuries. It was during this epoch that the first burials properly so-called were made. They were similar to present-day burials in that they were simple ditches sunk in the ground and were individual sepultures as opposed to the communal sepultures of the caverns; or of the dolmens of a later period. The dead were placed on the side, with arms sharply flexed at the elbows, bringing the hands to the region of the face; and the legs folded, bringing the knees near the breast. The same mode of burial was practised during the neolithic period of Egypt. Curiously enough, the same method of burial was used by the Indians of southern Connecticut before the advent of the Europeans.

Only 6,000 years is given for both the paleolithic and the neolithic period in Egypt, *i. e.*, from 10000 B.C. to 4000 B.C. For southern Europe the first epoch of the neolithic period is supposed to have begun about 5000 B.C., and the second epoch of the neolithic about 4000 B.C. These epochs began about 1,000 years later, respectively, in Scandinavia.

Copper was employed first in the Orient. It was known in Egypt as early as the first dynasty, about 5000 B.C. But its use was restricted and stone implements, particularly as cutting tools, were very generally employed until 3000 B.C. The Egyptian influence on the pre-Mycenæan civilization is noted and the characteristic stone burial cists of that epoch are described.

The beginning of the proto-Mycenæan epoch is placed at about 2000 B.C. With it appeared pottery of a new and much-improved order. The paste was fine, the modeling excellent and the ornaments in color. This epoch is known in Sicily, southern Italy and Sardinia by the sepulture *a forno*, so named because of its resemblance to an oven. Tombs of this type were communal and placed by preference in the flank of an escarpment. There also existed in these regions the dolmen proper. The two types of communal tomb are genetically related to the pre-Mycenæan stone cist. Strange to say, the dolmens spread to western Europe, Great Britain and Scandinavia, but did not replace in central Europe the ancient custom of individual burials.

The epoch of transition from the neolithic to the bronze age is called the "eneolithic" and corresponds to the Mycenæan. It was preeminently the age of the poniard, the spear and the lance coming later. Properly speaking, there was no eneolithic epoch in Scandinavia, although this epoch had a profound influence on northern civilization. For example, the flat-poled flint ax so characteristic of the north, and which is more recent than the flint ax with pointed pole, seems to have been copied after the copper axes of southern Europe at a time when metal was rare in the north and flint was plentiful. The dolmen also that characterized the eneolithic of the Mediterranean countries was introduced into Scandinavia during the first part of the neolithic period. The flint mines of Sicily and of Belgium are of the same type; but the former were worked by an eneolithic people and the process was borrowed by the races of Belgium before they emerged from a purely neolithic age. Not only flint, but also obsidian remained an article of merchandise well into the bronze age. Obsidian is easily traceable to its original sources in Italy, Sicily and certain islands of the Ægean sea. The finest example of the diffusion of flint from a single source is that of the Grand-Pressigny (Indre-et-Loire) which is recognized by its color and has been traced not only all over France, but also into neighboring countries.

Müller enumerates the fundamental principles that should guide one in studying the relations of the central to peripheral civilizations as follows:

1. Southern Europe represented the active productive civilizing force, while the countries to the north, being peripheral, played a receptive rôle.

2. The civilization of the south was transmitted only in abridged and modified form; subject in the more remote regions to a further development along entirely new and original lines.

3. Types of tools, weapons, apparel and ornaments may persist with but little change for a considerable lapse of time.

4. Elements which along the Mediterranean belonged to successive periods may become contemporaneous in the peripheral regions.

These principles were understood by the men who founded the science of prehistoric archeology during the last century. Müller believes that Montelius would make the prehistoric epochs of the peripheral region follow too closely those of the center. He also does not agree with Penka that Scandinavia itself was a center, a source of civilization; nor with Reinach, who regards Europe as independent of the Orient.

A chapter is devoted to the closing epoch of the neolithic period in the north, where stone art reached its apogee. The finest examples are the flint poniards that are so common in the dolmens of this epoch and that have their prototype in the bronze age—poniards of southern Europe. No such development of the later neolithic is to be found in the countries bordering on the English Channel, because the development in stone art was cut short by the introduction of metal at an earlier period.

Considerable space is given to the My-

cenæan civilization which reached its zenith about 1500 B.C. It is pointed out that the dwellings of the period were not of a permanent character, while the houses of the dead were built for eternity. "The tombs with cupola of Greece and the giant dolmens of Denmark are derived from the same conceptions of life and death and are fundamentally one and the same thing. Nothing better than these monuments could reveal to us the unity of European civilization, and at the same time nothing shows more clearly the differences between the south and the north during the second millennium B.C."

Iron was known in Greece toward the close of the Mycenæan epoch, but was employed only for small objects. Bronze was the metal in general use. One could therefore speak of this epoch as the bronze age. But Müller prefers Mycenæan for Greece and bronze age for the rest of Europe, where the civilization was much less rich, though derived from the same source, *i. e.*, from the Orient through Greece. The typical weapon of the bronze age was the poniard. The sword came later, not before the close of the period. The fibula made its appearance here and was the point of departure for the development of feminine ornament during the epochs to follow, and after having fallen into disuse for ages has only recently appeared in its original form, but with another name—safety pin.

One remarkable prehistoric phenomenon is the plentitude and decorative richness of the bronze age in Scandinavia and the mediocrity of the same civilization in western Europe. The latter was received indirectly by way of Italy, while the former came directly by way of Orient. In all western Europe from Spain to Great Britain there is not found a single fibula of the bronze-age type. This absence joined with that of the spiral ornamentation is proof that the Occident was farther removed from Greek influences than were the Baltic countries. The Mycenæan culture is supposed to have reached the north by way of the Adriatic, western Hungary and Bavaria.

The lake dwellings form an interesting phase of the prehistoric in Europe. They are grouped about the Alps. Switzerland, southern Germany, Savoy, northern Italy and Austria (including Croatia and Hungary). The structures were quadrilateral, a fact suggesting Mycenæan influence. At least 200 village sites have been discovered in Switzerland alone since the winter of 1853–4. These belong to different epochs, the later neolithic, bronze and iron ages, respectively. Some in fact were inhabited during successive ages. The purely bronze-age stations are found farther in the water than are the purely neolithic.

Just as curious in their way as the lake dwellings are the terramaras of northern Italy. This is a corruption of "terramarna," a name which was given to the low flat hillocks in the valley of the Po from which a fertilizing earth has been extracted since early in the eighteenth century, long before the real significance of the deposits was known. They owed their existence to pile dwellings built on land but protected by water artificially regulated. Over a hundred have been explored thus far. The finest one is at Castione, northwest of Parma. Its present height above the plain is only three meters but the thickness of the deposit is five and a half meters. Three successive villages had stood on the spot, the first two having been destroyed by fire. The terramaras represent preeminently a bronze age culture that came from Greece by the way of southern Italy.

The Dipylon epoch in Greece witnessed the appearance of a special geometric style of decorative art, consisting of straight lines and meanders. This art, developed about 1000 B.C., was not original and spontaneous. Although it consisted of old elements, these were brought together to form a new and harmonious ensemble. The same motives were in use a thousand years later in Scandinavia. Figurines of the horse characterize this epoch. Gold and silver were scarce. The use of iron became general.

The Dipylon epoch gave Italy its first iron age, which in its turn became the point of departure for a new period of civilization in the other countries of Europe. This period in Etruria was characterized by cinerary urns of coarse paste, made without the use of the

wheel and with incised instead of painted ornaments. The motives, however, recall those of the Dipylon epoch in Greece—zigzags, meanders, etc. All sorts of small objects were placed with the dead—among others the bronze razor with a single edge in place of the earlier two-edged razor; also, a new type of fibula with highly arched body instead of the Mycenæan type. There appeared at this time a sword with a hilt terminated by two branches—a type destined to play an important rôle north of the Alps as far as Scandinavia.

The first iron age in Italy is generally called the first Villanova epoch (1000 B.C.). It is also called the epoch of well-shaped tombs, *tomba a pozzo*. The second epoch of Villanova reveals an increasing Greek influence accompanying a local original development. Incineration gave place by degrees to interment; and ancient linear ornament was succeeded by life forms repeated in series to form zones, recalling the Dipylon style. Much progress was shown in the construction of tombs, as witness the celebrated tomb of Regulini-Galassi discovered in 1836 at Cervetri. After the fall of Carthage, Greek influence practically superseded the oriental in Etruria. After having given to Tuscany its money, alphabet, architecture, industry and divinities, Hellenic civilization crossed the Apennines and invaded the Po Valley. The best evidence of this is afforded by the Certosa cemetery at Bologna.

The first iron age of central Europe had its sources in the recent Villanovan civilization of northern Italy. It is commonly called the Hallstatt epoch, from the village of Hallstatt in Austria near which was discovered a prehistoric cemetery representing the entire period. But the Hallstatt civilization was as restricted in area as it was distinctive in character. This limited zone became a center of civilization for the contiguous countries, which for the most part were still in the bronze age. This was particularly true of Hungary, Scandinavia and Switzerland.

The second iron age, or epoch of la Tène, dating from about 500 B.C., is better known than the Hallstatt epoch. We know that toward the close of the latter period there arose in what now corresponds to France and Germany a special civilization which reached its zenith during the fourth century B.C. There was created at the commencement of the period a decorative Celtic style of such value and refinement as to be considered not only original, but also national. Yet in the last analysis these motives are derived from the palmette and classic volute. The Celtic period may be divided into two epochs: an older corresponding to the Gallic domination and a younger represented by the discoveries at la Tène on Lake Neuchâtel. The two halves of the Celtic period were of unequal merit, the latter representing an epoch of decadence. The period left its traces in Scandinavia, some of the specimens being of excellent workmanship. In both Scandinavia and Great Britain the bronze age was prolonged into the epoch of la Tène.

The movement of civilization in western Europe during the epoch of la Tène had its counterpart in the region to the north of the Black Sea, where the cemeteries of the time have furnished such a surprising quantity of beautiful objects of art, particularly gold ornaments. This rich period may be placed between the fifth and the second centuries B.C. As one penetrates farther into the interior of Russia the indigenous Scythian art makes itself felt more and more. It is characterized by animal figurines or simply the heads of animals used ornamentally. A good part of Scythian art and industry came direct from Asia and eventually spread its influence over northern Russia and into Hungary.

Rarely has a victory had for the history of civilization such vast consequences as the victory of Alesia, 52 B.C., by which Cæsar vanquished the last armies of Gaul. After this the frontier of the prehistoric domain retreated rapidly toward the north. The Germanic world came into direct contact for the first time with the classic civilization of the south.

During the epoch of invasions there was a marked development of provincial industry. The Roman bronze vases, for example, were no longer made in the south for exportation,

but in the region of the Rhine and in France. The sixteen beautiful pails from the cemetery of Hemmoor near Hanover are examples. One often finds Roman motives in use, but under forms scarcely recognizable. Among the most remarkable specimens of this kind belonging to the epoch of invasions must be classed the celebrated golden horns of Gallehus in Schleswig. To this period also belongs the Roman silver service found at Hildesheim.

Differences are pointed out between the recent Celtic civilization of Germany and that of Great Britain and Ireland. At the time the Romans gained a foothold in England local Celtic art had reached a high stage of originality and development. Celtic elements were even borrowed by the Romans, whose political domination over the land did not exercise any marked influence on the national art, which continued without interruption particularly in Scotland and Ireland, and which culminated in the heroic and legendary Celtic period of the first 500 years A.D.

The last two chapters are devoted to the closing epochs of prehistoric times in Scandinavia (500 to 1000 A.D.), and to Finland and the Slavic countries.

Müller, who is director of the National Museum of Danish Antiquities, has been known for years as a gifted writer on northern archeology. The present volume maintains the high standard the author set for himself in earlier works. Each chapter is accompanied by a selected list of references. One misses, however, an index which is all but indispensable in a work so important as this. The next general work on prehistoric Europe will in all probability devote more space to the contributions of such men as Rutot and Penck; those of the former on pre-Chellean industry and those of the latter on the antiquity of man from the standpoint of glacial geology.

George Grant MacCurdy
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Grundriss der Kristallographie fur Studierende und zum Selbstunterricht. Von Dr. Gottlob Linck. Zweite umgearbeitete Auflage. Pp. 254, 604 figures, 3 colored plates. Jena, G. Fischer. 1908.

Since the appearance of the first edition of this little text-book of crystallography twelve years ago it has remained the most satisfactory elementary treatise on the subject in any language. Unlike most text-books in the same field, it discusses crystallography in all its phases. Crystals are treated as bodies possessing certain well-defined properties in consequence of their structure, rather than merely as bodies characterized by distinct forms.

Starting with a brief statement of the difference between typical fluids and typical solids, the author develops the usual conception with reference to the growth of crystals, and follows this with descriptions of different kinds of crystal aggregates, a discussion of the symmetry of crystal planes, and statements of their simplest zone relations. The 32 classes of crystal forms are then treated in detail in 92 pages. In the first edition this discussion occupied 116 pages. The reduction is due to the omission from the new edition of some unnecessary explanations of figures, to the condensation of such explanations as are retained, and to a slight rearrangement in the order of treatment of some features of the subject. Everything essential to the understanding of the principles of geometrical crystallography remains, and in addition there has been introduced a most excellent series of photographs of crystal forms and combinations that will prove a welcome novelty to the student. On the whole, the first half of the revised edition does not differ materially from the corresponding portion of the earlier edition.

It is in the last half of the volume in which the greatest changes are observed. This now occupies 114 pages as against 93 pages in the first edition. The study of the physical properties of crystallized substances has advanced so rapidly in the past decade, and the results of these studies have become of such practical importance in physical and chemical investigations that they merit much more careful consideration than is usually given them in text-books published in the English language. Indeed, there is scant reference to

this phase of crystallography in English and American text-books, and in those in which the subjects are treated at all the discussion is so poorly developed as to be practically valueless for teaching purposes.

While the elements of physical crystallography are merely touched upon in the volume under review, the development of the discussion is logical and connected, and at every step the correlation between physical and geometrical symmetry is emphasized.

The most notable advance made in this new edition, however, is in the chapter dealing with the relations between the physical properties of crystals and their chemical composition. This portion of the book now occupies 26 pages, whereas in the earlier edition it occupied only 11 pages. Morphotropism, homomorphism, isomorphism, eutropism, polymorphism and isopolymorphism are illustrated by tables of substances exhibiting these properties, and the terms are explained in sufficient detail to serve the purpose of introducing the student into the fascinating field of chemical crystallography.

In all respects the volume will serve as an excellent text-book in elementary courses in crystallography. It is more comprehensive than the usual text-book pretending to deal with the subject, as it covers the field in all its aspects. The student is shown that crystals are not merely bodies possessing characteristic forms, but that they are bodies which also possess characteristic physical properties, and that such a close relationship exists between their geometrical, their physical and their chemical properties that these characters must be regarded as being connected genetically. That crystallography is a rational science and not merely a descriptive one is the impression left by the reading of the book. It is an impression to be greatly desired of American students, who are too apt to look upon crystals from the geometrical standpoint only.

The objectionable feature of the book is its lack of references. While this omission may be argued as possibly on the whole desirable in most elementary science text-books, in a text-book on general crystallography the omission is extremely unfortunate. The literature of physical crystallography is so widely scattered that a guide to the most important articles in this branch of the subject would certainly be convenient to the user of the volume. To advanced students—and that is the class to which Dr. Linck's book will most appeal, in America at least—a guide is absolutely necessary if the study is to be followed with any seriousness. It is to be hoped that in the next edition the author will insert at least a few references which will indicate where the most important discussions in physical and chemical crystallography may be found.

W. S. BAYLEY

The Cell as the Unit of Life. By the late ALLAN MACFADYEN, M.D., B.Sc. Edited by R. TANNER HEWLETT, M.D., etc. Pp. 381 and biographical notice. London, J. and A. Churchill; Philadelphia, P. Blakiston's Son & Co. 1908. $3.00 net.

The lectures brought together in this volume were delivered by the late Dr. Allan Macfadyen at the Royal Institution, London, during the years 1899–1902, and have been edited and published by Professor Hewlett as offering "some memento of a life full of promise and cut off all too soon." The difficult task, undertaken *con amore*, has been well performed by the editor, and a very readable and acceptable, although from its very nature somewhat out-of-date, "introduction to biology" lies before us.

The work is divided into sections, the first of which, under the caption The Cell as the Unit of Life, consists of five lectures on rather elementary biology in which a captious critic might find abundant material to feed his flame; if a morphologist he would take exception to such slips as that which speaks of the "Polar Body or Centrosome" (p. 57), or if a protozoologist to false impressions given by statements such as that on page 79 to the effect that always in feeding, "the *Amœba* seeks out and selects the alga cell." The second section, under the heading Cellular Physiology, is misleading in that little or nothing is said about physiology of the cell, the lec-

tures being devoted almost exclusively to fermentation and the actions of enzymes external to the cell and not intra-cellular activities. The cytologist looks here in vain for information regarding constructive and destructive metabolism, oxidation, etc., in the cell. He finds, however, an excellent and clear exposition of the kinds of ferments and of their importance in digestion in animals and plants, and in the first lecture of this second set he finds a most excellent illustration of the cost in labor of ascertaining a single scientific fact, a concise history of the development during the last two hundred years of our knowledge of fermentation being given. The third section of three lectures entitled Recent Methods and Results in Biological Inquiry, and the last section of four lectures on Toxins and Antitoxins, contain much repetition of the earlier lectures, but we find here a valuable elaboration of the lines of research in a field where Dr. Macfadyen was familiar with every inch of the ground. Here is an excellent summary of the effects of microorganisms as agents of disease and of immunity to and prevention of disease, all as understood at the time the lectures were written and well serving as a basis for those who would study the modern developments of these important lines of biological research.

G. N. C.

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Experimental Zoology, Vol. VI., No. 2 (February, 1909), contains the following papers: "Studies on Chromosomes, V., The Chromosome-groups of Metapodius, A Contribution to the Hypothesis of the Genetic Continuity of the Chromosomes," by Edmund B. Wilson. This contains a detailed account of the "supernumerary chromosomes," which form a specific class and vary in number in different individuals of the same species. The facts are shown to form a strong support to the general theory of the genetic continuity of the chromosomes, of which a general discussion is given. "The Effects of Desiccation on the Rotifer, *Philodina roseola*," by Merkel Henry Jacobs. The old question of the possibility of revival of rotifers after a more or less protracted desiccation is again taken up, and as a result of numerous experiments the older view that recovery is possible after a true desiccation is confirmed and the newer one that the animal at the time of drying is protected by a water-proof cyst is shown to be based on insufficient evidence. In addition, it is shown that the process of drying serves as a stimulus to reproductive activity, a definite relation existing between the periods of drying and those of egg laying. "Protozoan Studies," by J. F. McClendon. Amœbæ do not respond to minutely localized mechanical stimulation unless this be repeated at short intervals of time. By chemical stimulation it was found that the stimulus traveled through the *Amœba* at a rate probably faster than the movement of the fastest ions in aqueous solution. The movement of this stimulus might be compared to the nervous impulse, save that not being confined to a nerve fiber it spreads in all directions. Experiments suggested the following hypothesis of food taking by the *Amœba:* External chemical and physical processes cause a hardening and shrinking of the surface protoplasm, thus forming the ectosarc. Internal processes cause a liquefying of the protoplasm, thus forming the endosarc. Unstable equilibrium between these two sets of processes causes amœboid movements. A protoplasmic food body near the *Amœba* protects it locally from external processes and thus causes the *Amœba* to bulge out toward the food. That spot on the *Amœba* that touches the food is stimulated, hardens and ceases tc advance. Therefore lateral pseudopodia are formed and surround the food. Paramecia were centrifuged for periods of time up to one week. The nuclei, chromatin and other heavy substances were precipitated, but returned to their normal positions in about the length of time during which they had been centrifuged. The negative geotropism returned simultaneously with return of these substances. Centrifuging stimulated division. Centrifuging produced abnormalities and these were not transmitted to both products of binary fission. *Paramecium aurelia* formed membranous cysts and while in them often absorbed its own anterior or

posterior end. These were regenerated after liberation. The encysted Paramecia were killed by drying. From material obtained from a number of localities *Paramecium aurelia* was found to be dimorphic as regards size and the smallest specimens smaller than the smallest of *Paramecium caudatum*. "The Artificial Production and Development of One-eyed Monsters," by Charles R. Stockard. Salts of magnesium in solution are found to cause one-eyed monsters to develop from the eggs of the fish, *Fundulus heteroclitus*. These cyclopean individuals were produced in such numbers as to afford material for a full investigation of the processes involved in the formation of the defect.

BOTANICAL NOTES

VEGETATION PICTURES

SOME years ago Professors Karsten and Schenck, the former of the University of Bonn, and the latter of the Technical High School of Darmstadt, began the publication, through Gustav Fischer, of Jena, of a most interesting work under the title of "Vegetationsbilder." From time to time the successive parts have been noticed favorably in these columns, and now the reception of "Heften" 1 and 2 of the seventh volume calls for another notice. These are devoted to the vegetation of the volcanic regions of Java and Sumatra, and were prepared by Professor A. Ernst, of the University of Zurich, and the seventeen half-tone plates were made from photographs taken by him also. These plates are admirable examples of what may be done in the way of faithful reproduction, and make one wonder why it is so difficult, or perhaps even impossible, to secure work of this kind in this country at anything less than prohibitive prices. It is difficult to single out from these striking pictures those of greatest interest, but No. 5*a* showing pioneer vegetation on the volcano Merapi (2,981 meters), and No. 11*a* showing a grass steppe in the interior of the volcano Krakatau are especially noticeable. The text, of which there are twenty-four pages, is full and satisfactory. The excellence of the work, together with its very moderate price (2.50 Marks per heft) should make it one of the necessary works in every botanical library.

ANOTHER BOTANICAL JOURNAL

ON the first of January the well-known publisher, Gustav Fischer, of Jena, began the publication of a promising new monthly journal in the botanical field under the name *Zeitschrift für Botanik*. In size of page and number of pages for each number it resembles the *Botanical Gazette*, which in these respects was frankly taken by the projectors as the model for the new journal. The editors are Oltmanns, Solms-Laubach (who now withdrew from the *Botanische Zeitung*) and Jost, which fact is a guarantee of the high grade of the journal. This initial number consists of three parts, viz., (1) an original article of 86 pages; (2) reviews, covering 16 pages, and (3) a classified list of titles of new botanical books and papers. In the first paper there are 26 cuts, but this number contains no plates. The type and paper are good. The subscription price is fixed at 24 Marks. It will without doubt soon prove to be one of the most useful of the German botanical journals.

AMENDING THE VIENNA CODE

IN the February number of the *Bulletin of the Torrey Botanical Club* nineteen American botanists print eleven motions for amendments to the Vienna Code, and present arguments therefor. These motions are submitted "for the consideration of the International Botanical Congress to be held in Brussels in 1910." Briefly these motions cover the following points:

1 and 2. To apply these rules to fossil plants and non-vascular plants, which is not now done in the code. These appear to be desirable motions, and should be adopted.

3. To abolish the list of "Nomina conservanda," *i. e.*, names arbitrarily conserved contrary to the principle of priority. Here the contention of the committee is sound, and ultimately the code must be so amended as to conform to it, but whether this should be insisted upon at the present time admits of argument.

4 and 5. To change the rule requiring Latin diagnoses, to "Latin, French, English or German." The rule as adopted in Vienna is better, in our opinion, than the proposed modification.

6. To more clearly indicate valid and invalid naming of genera and higher groups. Here the committee's proposed amendments certainly make the rule more definite.

7. To provide for the disposition of the species when a genus is divided into two or more genera. Here again the committee's recommendation is much more specific than the rule in the code, and seems to provide for all the cases that may come up under it, which the original rule does not.

8. To provide for the proper retention of the original name in the division of a species. The committee's rule is much more specific and is a marked improvement upon the rule in the code.

9. To provide that priority of place upon the page shall be actual priority in the case of simultaneous publication of names. This is so reasonable that it should meet with no opposition.

10. To provide for the rejection of certain names by a more definite indication of the cases. The committee would reject "homonyms," "metonyms," "typonyms" and "hyponyms." Their statement is better than that of the code and may well be adopted by the congress.

11. To allow the specific name to be the same as the generic name, as in the familiar cases of *Taraxacum taraxacum, Linaria linaria,* etc. The Vienna Code requires the rejection of the specific name in such cases, in spite of the law of priority. The committee very properly regard this as "an unfortunate exception to the general law of priority."

On the whole it seems that this committee of American botanists is warranted in presenting its motions for amendments. With the exception of the fourth and fifth, relating to the diagnoses of new groups, we hope that these motions for amendments will be adopted.

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SPECIAL ARTICLES

A DISCUSSION OF SOME OF THE PRINCIPLES GOVERNING THE INTERPRETATION OF PRE-PERSOONIAN NAMES, AND THEIR BEARING ON THE SELECTION OF A STARTING-POINT FOR MYCOLOGICAL NOMENCLATURE[1]

If there is any one fact which more than others has become increasingly evident during the last thirty years in the study of fungi it is that a thorough examination of their microscopic characters is necessary for the certain determination of most of the species. The older systematists based their species entirely upon external characters. While the spores of fungi were early observed, they were regarded as of no importance systematically, and even as late as 1849 Fries himself forcibly stated that in the whole family of Discomycetes no natural genera could be based on carpological characters. In the decade between 1860 and 1870, however, influenced by the work of the Tulasne brothers and of de Bary, systematists turned their attention more seriously to the study of microscopic characters, and it at once became evident that important diagnostic marks were to be found in structures too small to be seen with the unaided eye. The great amount of careful morphological and developmental work which has been done among the fungi during the last thirty-five years has only emphasized the importance which should be attached to microscopic characters in distinguishing genera and species in this group. To such lengths has this tendency developed that in recent years whole systems of classification have been proposed based almost entirely on microscopic features, and in the eyes of all workers such characters have come to be regarded as the most important available bases for generic and specific distinction.

This method of study has frequently developed the fact that two or more plants, externally indistinguishable, really represented as many different species or even distinct genera. Illustrations of this condition are

[1] A paper read before the Botanical Society of America at its meeting in Baltimore, December 31, 1908.

very numerous among the Ascomycetes, and will at once occur to any one at all familiar with the fungi. A few concrete examples will perhaps put the matter in a more definite light. The genera and species of the Phycomycetes are based almost entirely on microscopic characters. Among the powdery mildews the genera *Sphærotheca* and *Erysiphe*, as well as *Podosphæra* and *Microsphæra*, can not be distinguished from each other without the use of the microscope. Most of the genera and species of the Pyrenomycetes are founded on characters drawn from the asci and spores, which can not be made out with the unaided eye. Among the Discomycetes the genus *Trichoglossum* is represented in America by about half a dozen species which are indistinguishable by their gross features. The genera *Geoglossum* and *Corynetes* can not be told apart by external characters. The same is true of *Barlæa* and *Humaria*, *Sphærospora* and *Lachnea*, and many others. In nearly all of these genera are whole groups of well marked species which are based entirely on minute microscopic characters. Specific limits among the rusts, smuts and other groups are too familiar to need mention. On the other hand, it is equally true that there are certain fungi which are so unique and well marked that they stand off by themselves, and can be much more certainly recognized by external features alone. Such species occur more commonly among the larger fleshy and woody forms, but even here minute hymenial characters are recognized as being of the greatest systematic importance. No one can venture to assert that careful students of these better marked forms may not soon discover microscopic features at present unused which may entirely upset our ideas of their specific limits. It is not necessary to dwell further on this phase of the subject, for the facts are too familiar to need elaboration. Enough has been pointed out to emphasize the fact that the number of species of fungi which may be placed with certainty on the basis of external characters alone is comparatively small.

If, therefore, the accurate determination of most of the species of fungi on the basis of gross characters alone is next to impossible when the living plant is actually before one, how much more uncertain must be the identification of the species of older writers, which are represented by only brief descriptions of the most obvious external features, or at best by figures often crudely drawn or inaccurately colored. The simple fact is that the majority of the species of fungi described by writers before 1800 can not be recognized with certainty at the present time, when measured according to present-day standards. Yet systematic literature is filled with the references of well known fungi to names dating from Linnæus, Scopoli, Jacquin, Batsch, Bulliard, Paulet, Schaeffer, Adanson, Schrader and many others, the majority of which are at best involved in doubt. Of course it is perfectly possible for one to speculate on the probabilities in such cases, but positive conclusions can never be inferred from doubtful premises, and he will be no nearer definite knowledge at the end of his speculations. The writer firmly believes that in the field of systematic mycology a single gram of knowledge is of more value than kilos of guess-work, supposition and uncertainty, and he wishes here to raise the question and to invite discussion as to whether the time has not come to take steps to eliminate from consideration these old names, the great majority of which can never be definitely fixed.

We are thus led naturally to inquire Why should mycological nomenclature date from Linnæus's "Species Plantarum" of 1753, and thus include this mass of undeterminable names? While Linnæus had a good understanding of vascular plants the distinguishing characters of which are gross and external, his knowledge of the lower organisms, especially of algæ and fungi, was very slight. Indeed, it seems probable that very little that he wrote concerning the fungi was based on his own first-hand knowledge, but that his work with these plants consisted principally in the application of binomial designations and brief descriptions to those figured by his predecessors. The distinguished botanists of Harvard University have stated the matter so admirably that I can do no better than to quote from them as follows:

Although the year 1753 seems eminently desirable as the starting point for the nomenclature of the spermatophytes, the use of this date among the lower groups, as for instance the algæ, appears not only highly inexpedient but well-nigh farcical. Among the flowering plants both genera and species had by 1753 been interpreted with a tolerable degree of definiteness, and their descriptions were at that time drawn with sufficient understanding of morphological and diagnostic features to make them in general intelligible to future generations. On the other hand, at the date of Linnæus's "Species Plantarum" the knowledge of the algæ was far too crude to form a satisfactory basis for their classification or nomenclature. Even the optical appliances necessary for the intelligent examination of this group had not been invented. What is here said of the algæ is quite as true of the fungi and applies in lesser degree even to the bryophytes and pteridophytes. Furthermore, the great difficulty or impossibility of preserving specimens in several of the lower groups, and the consequent fact that no type specimens are now extant for a large proportion of the species of the lower orders, render it all the more imperative that the beginning of nomenclature in these groups should not be carried back to a time of brief, vague and unintelligent descriptions.

In consideration of these facts it seems desirable that in the nomenclature of the spermatophytes priority should be reckoned from the publication of Linnæus's "Species Plantarum" in 1753, but in the case of all other groups, from a date near 1800, to be more exactly determined by a committee of specialists in cryptogamic botany, appointed by the International Congress in whatever manner it may seem best.[3]

Acting with a knowledge of the facts so comprehensively stated in the quotation just given certain algologists are advocating the selection of much more recent dates as the points of departure for the nomenclature of certain groups. Why should not students of the fungi do the same; and, if any such action is to be taken, what is the most desirable date to be selected? The writer has seen only a single definite proposition bearing on the selection of such a starting-point, and ventures to offer the following suggestions in the hope that they may stimulate discussion of the matter.

[3] "Amendments to the Paris Code of Botanical Nomenclature," p. 13, 1904.

It may be well to point out at once some of the considerations which should have weight in the selection of a starting-point for mycological nomenclature. In the first place there should be, if possible, a common point of departure for all groups of fungi. Secondly, the date selected should be early enough to include the greatest possible number of published names. Thirdly, it should, if possible, mark the beginning of some important epoch in mycological history. Fourthly, the personage whose work is chosen should be one of the most prominent in the development of systematic mycology. Fifthly, the specific work selected should be a comprehensive one which deals with all the principal groups, which summarizes what has been done before, and which, in a word, bears about the same relation to the classification of fungi that Linnæus's "Species Plantarum" does to that of the vascular plants. Sixthly, and perhaps most important, it should be the work of a person who preserved a considerable proportion of the specimens on which his publications were based, and whose collection is now available for examination, so that his names can be fixed with some degree of definiteness.

It would be too much to expect that any one work should be in all respects ideal, and it would be impossible to select one which would not be open to some objection, but the one which in the opinion of the writer comes the nearest to fulfilling all the requirements named above is Persoon's "Synopsis Methodica Fungorum," published in 1801.

A brief historical sketch will make clearer the reasons for this opinion. The development of systematic mycology covers three quite distinct periods, each of which is marked by its own peculiar point of view and characteristic method of work. These may be designated as (1) the pre-Persoonian period or period of the illustrators, (2) the Persoon-Friesian period or period of the systematists, and (3) the modern period or period of the morphologists. The first period covers approximately the last three quarters of the eighteenth century, extending from about 1725 to about 1800, and as characteristic may

be cited the work done by Vaillant, Micheli, Schmidel, Schaeffer, Batsch, Holmskjold, Bulliard, Paulet and Sowerby. These men were all essentially illustrators. In their publications the larger and more conspicuous fungi were figured with some care and usually in color. Their plates were accompanied by descriptive text which, of course, dealt only with the gross and external features of the plants discussed. In most cases names were applied to the plants illustrated. Before the time of Linnæus these were mostly descriptive polynomials, but later the binomial method of designation was employed. Although the illustrators came to group their species in several genera on the basis of the most obvious superficial resemblances, no attempts were made by any of them to perfect a systematic arrangement of the fungi which could be at all compared with those which had been worked out for the flowering plants during the same time. In only a few instances have any of the fungi illustrated in this period been preserved so that aside from the information conveyed by the descriptions and figures we have no means of determining what plants the authors had before them. The writer has already attempted to show that the majority of the species of fungi described in this period can not be recognized with certainty at the present time, when measured according to present-day standards. The information about fungi in this period was in a much more crude and unsystematized state than that which prevailed concerning the spermatophytes before the time of Linnæus. It is primarily of historical rather than scientific interest, and consequently can be left out of consideration without any resulting serious loss to scientific knowledge. Surely no logical starting-point for mycological nomenclature can be found in this archaic period.

The second period of mycological history covers approximately the first two thirds of the nineteenth century, extending from 1800 to about 1865. With the advent of Persoon a complete change came over the aspect of mycological study. The attention of workers was turned from the illustration of fungi to their classification and systematic arrangement. The work of this strange man in his garret at Paris either directly or indirectly profoundly influenced that of such students as Wahlenberg, Fries, Schumacher, Nees von Esenbeck, Corda, Ditmar, Rabenhorst, Schweinitz, Duby, Desmazières, Leveillé, Montagne, de Notaris, Berkeley, Broome and many others who came after him, and whose names are familiar as household words to the mycologist. As the result of their labors immense numbers of new species were brought to light, their external features described, and arranged according to the then approved systems of classification. This method of work characterized the second or Persoon-Friesian period of mycological development.

While Persoon's publications before 1800 were of minor extent, yet they introduced an entirely new point of view. Persoon really originated systematic mycology. The "Synopsis Methodica Fungorum," of 1801, is one of the few epoch-making mycological publications. Not only was it the pioneer work of its kind, but it became the direct foundation of the Friesian system of arrangement which remained in almost universal use for half a century. While the Persoon-Friesian methods of classification are not those in use today, they were probably the best which the existing knowledge of fungi permitted, and they undoubtedly served their purpose fully as well as did the Linnæan system among the seed-plants.

Persoon's "Synopsis" was a comprehensive work in that all the groups of fungi known at the time were treated. It was synoptical in that its author went over the works of his predecessors, brought together the scattered descriptions, and either incorporated the names directly or arranged them as synonyms as seemed to him warranted by the evidence at his command. The "Synopsis Methodica Fungorum" therefore bears about the same relation to the systematic arrangement of the fungi that Linnæus's "Species Plantarum" does to that of the spermatophytes. The same reasons which led to the adoption of the latter as the starting-point for the nomenclature of the higher plants should cause Persoon's work to be chosen for that of the fungi.

While it is true that Persoon, and nearly all the students of fungi in this period, studied only external characters, it is equally true that Persoon and Fries and the majority of the workers of their time *preserved a considerable number of their fungi*, and their collections are now available for study. The result is that a majority of the names from Persoon down can be fixed with a degree of definiteness which is impossible for those described before his time. Objection may be raised that many of Persoon's types are missing from his herbarium; that herbarium specimens are liable to become interchanged, and that in other cases it is often difficult or impossible to determine just what his type of a particular species was. There is undoubtedly force in this argument, but it must be admitted that specimens, although sometimes confused, are the most reliable bases for determination that we have, and the same objections may be brought against any other collection, even against some of those of quite recent date.

Some mycologists, perhaps, might be willing to begin their nomenclature with Persoon, but would urge that his more mature and elaborate work, the "Mycologia Europæa," should be chosen as the starting-point. To the mind of the writer the principal objections to starting with this later work are: (1) That its publication extended over several years, from 1822 to 1828; (2) that it was almost exactly contemporaneous with another equally, if not more important work, the "Systema Mycologicum" of Fries; (3) it, therefore, does not stand out in a class by itself at the beginning of an epoch.

It has been suggested by certain students of fungi that the "Systema Mycologicum" of Fries should be used as the starting-point for mycological nomenclature. While the writer recognizes fully that this work is one of the most important and influential systematic mycological contributions yet produced, and that scientifically it was a great advance upon the "Synopsis Methodica Fungorum" of Persoon, yet he believes that no lack of appreciation of its value is shown in the conviction that it is not so natural a starting-point for nomenclature as is Persoon's work. The following reasons may be given in support of this opinion: (1) The publication of the "Systema" extended over several years from 1821 to 1832, a long period of time which would, in fact, establish different starting-points for the various groups of fungi. (2) In the year of publication of each of the earlier parts appeared important works by other authors (*e. g.*, S. F. Gray, 1821; Persoon, 1822; Schweinitz, 1822; Greville, 1823), in which cases it would be difficult if not impossible to determine priority of publication. (3) It, therefore, does not stand out in a class by itself at the beginning of an epoch, but is one of a number of publications on the same subject which appeared about the same time. (4) While Fries's system of classification was much more elaborate than that of Persoon, and showed a better understanding of relationships and of the relative value of characters, it was in many, if not most, of the groups founded directly upon that in Persoon's "Synopsis."[3] (5) Fries's species are no more capable of positive identification at the present time than are those of Persoon.

The third period in the development of mycology began in the decade between 1860 and 1870, when the second and most important change came over the aspect of the study of fungi. This movement was inaugurated by the publication of the Tulasnes' "Selecta Fungorum Carpologia" (1861–1865) and of de Bary's "Morphologie und Physiologie der Pilze, Flechten und Myxomyceten" (1866). Most of the work done before this time had consisted in the almost interminable species-making on the basis of the external and gross features of the plants examined, but from this time on the attention of students was directed to the study of the morphological details and the development of fungi, a kind of investigation which has laid the foundation for sounder systems of classification. In some respects it would be better to start the nomenclature of fungi with some important work in which the

[3] For a concrete example see the present author's analysis of the relation of Fries's classification of the fleshy discomycetes to that of Persoon in *Bull. Torr. Bot. Club*, 27: 464–466, 1900.

more modern ideas of classification are made use of. There is, however, no great epoch-making work in this period which is adapted to being made such a starting-point, and, moreover, the selection of such a late date would exclude a very large proportion of the known genera and species of fungi, which had been described before the period began.

The question will naturally arise in the minds of some Why, after all, is it necessary to fix a special date for the beginning of nomenclature of the fungi? It is manifestly impossible to adopt any starting-point which will effectually remove from consideration all the vague and uncertain names. Why not leave the matter open? Let monographers trace the history of each species and adopt the earliest name which can with certainty be applied to it, and relegate the uncertain names to the limbo of species ignotæ. One may reply to such objections that the whole matter is one of expediency; that while many of the names published after 1801 must always remain undeterminable on account of the absence of authentic specimens, the majority can be definitely identified because the describers preserved the specimens on which the names were based; that while some of the names published before 1801 were applied to plants so unique that they can be placed with reasonable certainty without specimens, the majority can never be accurately, or even approximately, determined for the reasons already pointed out; that as long as the way remains open attempts will be made continually (as has been done in the past) to revive these archaic names on the basis of supposition and a discussion of the probabilities in each case, a kind of reasoning which can never lead to definite conclusions, but which must always be productive of uncertainty and difference of opinion, with a consequent continued unsettled condition of the nomenclature of even the commonest fungi. For these reasons the writer believes that a special starting-point should be adopted so that a large proportion of these vague, indefinite, unintelligently characterized names which can never be definitely fixed should be effectually disposed of.

The writer would, therefore, urge the adoption of Persoon's "Synopsis Methodica Fungorum," of 1801, as the starting-point for mycological nomenclature for the following reasons:

1. The names applied to fungi before the time of Persoon should be excluded from consideration for the reason that the majority of them can never be definitely and certainly identified.

2. Any publication in the modern period is too recent and exclusive, a large proportion of the systematic work with fungi having been done before it began.

3. Its date of publication is early enough to include a great majority of the published names of fungi, and nearly all of those which can be certainly fixed at the present time.

4. Its publication marks the beginning of the second important epoch in mycological history, that of the scientific study of fungi.

5. It is the first important systematic work of the founder of systematic mycology, and is therefore the logical point with which to begin the nomenclature of the subject.

6. It is a comprehensive work which can be used as well as any other as the common point of departure for all groups of fungi.

7. It is a synoptical work which summarizes what had been done before its time, so that it bears about the same relation to the classification of fungi that the "Species Plantarum" of Linnæus does to that of the seed-plants.

8. Persoon's herbarium is in existence and is available for study, so that a considerable proportion of his names can be fixed with a degree of definiteness which is impossible for those published before his time.

9. It possesses an advantage over the "Systema Mycologicum" of Fries in that it was published within the limits of a single year in which no other important work on mycology appeared, so that it stands alone in a class by itself at the beginning of an epoch.

10. The adoption of this date would remove the incentive for much guess-work and speculation on the probable identity of many of the vaguely and unintelligently described or crudely figured species of fungi, which must always remain incapable of certain identifica-

tion, and would thus contribute materially to the stability of mycological nomenclature.

ELIAS J. DURAND

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SOCIETIES AND ACADEMIES

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 456th meeting was held March 6, 1909, with President Palmer in the chair. Dr. Theodore Gill offered some notes on oral gestation in cichlid fishes. He said that there was much to learn about the habits of American cichlids and especially about their buccal incubation. Professor Putnam as long ago as 1863, in the *Proceedings* of the Boston Society of Natural History (p. 226), remarked that "in the genus *Bagrus* [really *Arius*] Professor Wyman found that it was the male that took charge of the eggs, while in the Chromoids [*i. e.*, Cichlids] it is the female. The specimens in which this peculiar fact was noticed were presented to the Museum of Comparative Zoology by Rev. J. C. Fletcher, from the Rio Negro, and by Professor Wyman, from Surinam. In these specimens the eggs and young were found in all stages of development."

This statement has been universally overlooked and various authors, especially Lortet and Günther, maintained that it was the male that took charge of the eggs, and not till 1902 and later did Boulenger and Pellegrin demonstrate that it was always the female of Syrian and African cichlids that did so. There was much uncertainty about the American species and the genus comprising the "two species" observed by Putnam was not named. It was probably *Geophagus*.

Very recently, in an article on the "Freshwater Fishes of French Guiana" extracted from the *Revue Coloniale*, Dr. Pellegrin claimed that it was the male of the American *Geophagi* that nurses the eggs; his words are "Chez les Géophages américains c'est le mâle qui se charge ainsi des soins à donner aux œufs et aux jeunes; chez les Cichlides africains comme les Tilapies, c'est la femelle ainsi que M. Boulenger et moi l'avons montré."

It is improbable that the American species differ so decidedly from the African and the neglected half-century-old observations of Wyman and Putnam deserve resurrection. Perhaps the specimens observed are still in the Museum of Comparative Zoology and can be identified by Mr. Garman or Professor Eigenmann. Agassiz in his "Journey to Brazil" in 1865 made some observations but did not state whether the egg-carrying individuals were females or males.

Now that much attention is being paid to the breeding habits of fishes, we may hope that definite observations will soon be made of American cichlids. Some, indeed, have been published by German aquarists which appear to show that there may be considerable difference in the habits of the species, but the information is still unsatisfactory. May this note serve to elicit more definite data.

Dr. L. O. Howard referred to the importation of the brown tail moth accompanying seedlings from France. It is a practise of American nurserymen to buy seedlings from the north of France. Thirty per cent. of a recent shipment carried the winter nests of the moth. There is no national inspection law in this country and the stock had become widely distributed before its infection was known. Much of it was later traced and destroyed under state laws. An old federal law forbids the carrying of such infected stock in vessels, and steamship companies after a warning are now more careful in this respect. A protest from the French nurserymen alleged that the brown tail moth would not thrive in our northern states, and was already common in the southern states. But the fact is that in this country the moth is a great pest in the northern states to which it is confined.

The chair referred to the reservation by executive proclamation under the Monuments Act of several regions containing objects of scientific interest. The recent creation by President Roosevelt of the Mt. Olympus National Monument in the Olympic Mountains of Washington, the home of the Roosevelt elk, is the first of its kind having a zoological as well as geological interest.

Dr. Evermann called attention to a recent act of Congress which provides for the establishment of a biological station at Fairport, Iowa. An appropriation of $25,000 for the establishment of this station was made a year ago and recently Congress passed the item providing for the personnel. The site has been definitely selected at Fairport, Iowa, where the bureau has acquired sixty acres of land admirably suited to the purpose. About fifty acres of the land lies along the river front and is exceedingly well adapted to the construction of the necessary ponds, of which there will be several acres. Near the river front is a railroad used by two companies with a number of trains each way daily, thus affording adequate railroad facilities. Some 1,800 feet from the river front is a public highway connecting

Muscatine and Davenport. Just above the highway the ground rises into a low bluff near the base of which are beautiful locations for the director's residence and such other residences as may be required. The laboratory proper will doubtless be located on the lower land just below the public highway.

It is the intention of the Bureau of Fisheries to make this in every respect a well equipped biological laboratory where any and all problems concerning the aquatic life of the streams and lakes of the upper Mississippi Valley may be studied. The primary and most important purpose of the station will be the carrying on of experiments and actual culture in connection with the artificial propagation of the Unionidæ or fresh-water mussels. The shells of various species of fresh-water mussels are now being used extensively in the manufacture of pearl buttons. The industry centers at Muscatine and Davenport, between which two cities the biological station will be located. The business now utilizes more than 50,000 tons of these shells and produces an output of $6,000,000 worth of buttons and by-products annually. Naturally this heavy drain upon the supply of shells will soon lead to the depletion of the beds unless something can be done toward the artificial propagation of the species. Drs. Lefevre and Curtis, of the University of Missouri, have fortunately developed, purely through scientific investigation, methods by which several of the species can be propagated very successfully, and it is the intention to carry on mussel-cultural work of this kind very extensively at the Fairport station.

In addition, however, to the mussel-cultural work, it is the intention to equip this laboratory in such a way as to furnish adequate facilities for the study of the various species of fishes and other aquatic animals and aquatic plants of the upper Mississippi basin, and it is believed that this will appeal to the biologist of that region as well as of the entire country.

The personnel provided consists of (*a*) director, (*b*) superintendent of fish-culture, (*c*) two scientific assistants, (*d*) one shell expert, (*e*) one engineer, (*f*) two firemen and (*g*) two laborers. Construction work on the station will begin early in July and it is hoped that the station may be ready for work by November.

The following communications were presented:

Chickens without Feathers: R. H. Chapman.

Illustrations were shown of fowls that had failed in normal feather development. The birds were observed at Delhi, N. Y., during the summer of 1908. About 500 chicks of the barred Plymouth Rock variety were incubator hatched during June. They were all apparently normal for a short time, but about ten per cent. failed to grow the usual covering. The photographs shown were taken in November and the birds were about four months old, and included the fully feathered as well as naked birds. The death rate among the freaks was high, though some of them lived until the cold weather set in. The only clew to an explanation given was the fact that the parents of the chicks had been persistently inbred for some four years. The phenomenon has been previously observed at farms in Virginia but never in such a large proportion of the hatching.

Résumé of a Study of the Madreporaria of the Hawaiian Islands: T. Wayland Vaughan.

The Recent Crinoids and their Relation to Sea and Land: A. H. Clark.

The speaker discussed the distribution, ecology and coloration of the recent crinoids, following closely his paper on the subject published in the *Geographical Journal* (London) for December, 1908; he said further that the predominating purple or violet in the littoral species may be a factor of great importance in their economy, for many of the small organisms upon which they feed are strongly attracted by the violet rays of the spectrum, and hence would tend to swim toward a purple or violet crinoid, placing the latter in the economically advantageous attitude of attracting to itself, instead of having to pursue its food. *Uintacrinus* was cited as an instance of a purely pelagic derivative from the common comatulid stock; in life it probably floated with its globular body upward and its arms dependent downward, just like the similarly built jelly-fish of recent seas; it lived in great masses, as do many recent medusæ, and this was probably an advantage, for these masses would shade the water immediately beneath them, and many of the small lucifugous organisms would take refuge in this shade, only to be picked up and eaten by the *Uintacrinus*. The occurrence of crinoids in large masses of individuals all of which are of approximately the same size was explained by the inability of the young of the mass to obtain a food supply when shaded by the arms of the adults; hence the young can not survive unless drifted to some distance from the parents.

The 457th meeting was held March 20, 1909, with President Palmer in the chair. The program consisted of an illustrated discussion of "Camp-

ing and Camp Outfits," by A. S. Hitchcock, V. Bailey, H. S. Barber, W. H. Osgood, J. W. Gidley and E. A. Preble. Articles of camp equipment were exhibited, methods of carrying packs demonstrated, and many lantern slides shown.

M. C. Marsh,
Recording Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

The 663d meeting was held March 27, 1909, Vice-president Wead in the chair. Two papers were read.

The Present Status of Wireless Telegraphy and Telephony: Dr. L. W. Austin, of the Bureau of Standards.

Two years ago there were four principal practical problems before the workers in radio-telegraphy:

1. Doing away with the irregularities of the atmospheric absorption of the signals which caused waves of the same intensity to be at one time detected at a distance of 1,000 miles, at another not over 100.

2. The elimination of the disturbances in the receiving station due to atmospheric discharges which frequently made the reception of signals entirely impossible.

3. The production of directed signals capable of commercial use.

4. The production of electrical oscillations suitable for wireless telephony.

The first of these problems has been successfully attacked by Professor Fessenden, who has shown that by using a wave-length of approximately 4,000 meters the absorption is much reduced and becomes practically constant under all conditions both by day and night.

The second problem is still not satisfactorily solved, although the conditions are much improved by sharper tuning of the receiving circuits and especially by the use of a loose coupling of the receiver.

In regard to the third problem, a certain amount of success has attended the experiments of Marconi, who by using a bent antenna has succeeded in giving direction to the electrical waves. Bellini and Tossi in France have also obtained very satisfactory results by the use of a kind of loop antenna.

In wireless telephony, continuous trains of oscillations produced either by the arc or by means of high-frequency dynamos have been so far improved that the range of working has been increased from about 10 miles to over 200.

A Calorimeter for the Determination of the Specific Heat of Liquids: Mr. H. C. Dickinson, of the Bureau of Standards.

A Dewar flask of the ordinary spherical form, of five liters' capacity, has been adapted for use directly as a calorimeter for measuring the specific heat of liquids. The particular problem attacked has been the measurement of the specific heat of calcium chloride solutions at low temperatures. For this purpose the flask is immersed in a mixture of ice and water and filled with the solution to be tested, cooled to the lowest temperature its concentration will permit.

The method consists in accurate measurements of the temperature of the weighed contents of the flask, alternating with short periods during which energy is supplied electrically to raise the temperature of the liquid. The temperature is raised by steps of about 5° C. and the energy supplied, and the corresponding rises of temperature are measured for each 5° interval. Such a series of observations with a single sample of solution, occupying about one and a half hours, gives a specific heat for intervals of 5°, between $-30°$ C. and $+20°$ C.

The water equivalent and radiation constant for the calorimeter were determined with great care by a separate series of experiments, using pure water. The water equivalent of the calorimeter, stirrer, thermometer, etc., is only about 2 per cent. of the total water equivalent of the solution used.

The total correction for radiation with a temperature difference of 30°, amounts to only about two per cent. of the energy supplied.

The energy, supplied electrically, is measured to about 2 parts in 10,000 by means of a potentiometer in connection with a standard 0.1-ohm shunt and a volt box.

Temperature differences are measured by means of a resistance thermometer having a sensibility of about 0°.0005 C.

The time intervals necessary in computing the total energy are measured by means of a tape chronograph to about 0.02 second.

The following table gives the values found for the specific heat of solutions of chemically pure calcium chloride and water of different densities, where t is the temperature in degrees C.:

Density	Specific Heat	Temperature
1.07....	$0.869 + 0.00057\,t$	$(-5°$ to $+15°)$
1.14....	$0.773 + 0.00064\,t$	$(-10°$ to $+20°)$
1.20....	$0.710 + 0.00064\,t$	$(-20°$ to $+20°)$
1.26....	$0.662 + 0.00064\,t$	$(-25°$ to $+20°)$

R. L. Faris,
Secretary

SCIENCE

FRIDAY, APRIL 30, 1909.

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE FUNCTIONS AND ORGANIZATION OF THE AMERICAN SOCIETY OF NATURALISTS[1]

THE American Society of Naturalists was founded, under the name of The Society of Naturalists of the Eastern United States, in 1884, by a group of the leading biologists of the day. Some of these have long since passed away. Others yet remain with us and are among the most active and most distinguished representatives of biological science in America to-day.

The motives underlying this movement are not difficult to discover. They are to be found in the great trend toward an intense specialization which at that time began to attract wide-spread attention and called for great concentration of effort and more exacting methods; in the rapid development of a refined and precise technique; in a growing demand for improved science teaching in schools, and in an appreciation of the fact that the arbitrary distinctions hitherto maintained between the two great schools of biological research must shortly disappear in joint efforts toward the solution of the great problems of life. The logical outcome of this point of view necessitated careful consideration of the relations in which the new order of scientific thought and progress must stand toward methods of research and the constitution of societies and academies of science.

But above all, it became a matter of first importance to determine the relations of the new order to the rising generation and through them to the future specialist and scientist. In other words, it became clear that the methods of science teaching must

[1] Presidential address delivered at the Baltimore meeting, December 31, 1908.

be made to so far conform to the trend of scientific thought and to actual progress, as to secure to the public at large correct conceptions, and to the future student of science a proper basis on which to found more advanced studies. It is, therefore, in no way surprising to find that some of the very first discussions of the newly formed society were directed toward a careful consideration of "methods of teaching" and "the employment of specialists by the educational institutions of the country."

It is not our present purpose to analyze fully the important influences which have extended from these discussions broadcast over the land, carrying with them the full weight of the highest authorities of the day, as it would take us altogether too far from the immediate purposes of this address; but it is, nevertheless, worth our while to point out that the spirit of cooperation in scientific endeavor, the high purpose to influence and improve the standard of scientific thought and effort, and the intention to so dignify and enrich scientific achievements that the society might stand as an exponent of the highest and best scientific thought, and as an inspiration to the rising generation, were ideals which constituted the fundamental concept and have been adhered to during the quarter of a century of usefulness which has marked the career of this institution. It was in this spirit that the society set before itself lofty ideals of usefulness, and in the period that has since elapsed I fail to discover that there has been any retrograde step or any serious lapse from the first declaration of policy. The only opportunity for criticism would appear to lie in the possibility that this policy, while fully maintained, has not proved sufficiently elastic to permit of ready adjustment to altered conditions imposed by the lapse of time and the progress of scientific thought; but I am not prepared at this time to admit that such is, in reality, the case.

This society numbers, to-day, 376 members, among whom we proudly reckon the majority of the leading scientific men of the country, while in its organization it represents a powerful, coordinating and centralizing body for various groups of specialists joined for their particular purposes into small societies devoted to restricted lines of research. Few will venture to deny the preeminent position the society occupies, the great influence it has exercised or the eminent character of its work. Nevertheless, we are suddenly faced with a grave problem which threatens nothing short of the very existence of the organization.

Within the last two years we have heard much to the effect that the society is in a moribund condition, that its usefulness is a thing of the past, and the faint-hearted even insist that it is time for it to gracefully die. These statements have been repeated with such insistence and frequency, in spite of the firm belief of many that the society has a very definite and important function to perform, and that never in its history or in the history of science, was there a time when its efforts and influence were more needed than now—that the more progressive, and, I am also bound to say, the more thoughtful among us are led to consider the situation as one which requires to be dealt with firmly but without further delay, to the effect that the usefulness of the society and its functions must be redefined in the light of present-day needs and present-day conditions, and that it shall be rehabilitated. Or, failing this, that it shall be promptly and finally relegated to the things that have served their purpose and no longer meet a want in the economy of scientific thought and development—that its career must be terminated. This is the direct issue with which every member of

this society is faced to-day, and the result must be determined by the vote which you will presently be called upon to cast.

My task is certainly not a congenial one, but as your president to whom the issue has been presented in a most unexpected manner, it is my duty to bring before you as clear an analysis of the situation as it is possible for me to give, and then leave the final decision in your hands.

In the last presidential address delivered to this society, Dr. McMurrich defined the great function of the Society of Naturalists in a very concrete but comprehensive phrase, when he said that "It makes for the solidarity of those sciences which, in the older days, were included in the term natural history," and he then proceeded to show how the necessary development of the biological sciences in particular wrought a change in the work and character of the society, and even threatened to obliterate its *raison d'être*. It is not my purpose to enlarge upon the line of thought which these remarks naturally suggest, but rather to employ them as the starting point for further consideration of those activities which properly devolve upon an organization of this kind, to indicate further directions of usefulness, and, if possible, convey to the minds of my hearers some small measure of that conviction which assures me that there is, more than ever, an open, fertile and as yet unoccupied field which it should be our special duty to cultivate in the interests of pure science.

One of the essential features in the activity of the Society of Naturalists has been the opportunity for the unreserved discussion of abstract scientific problems in which specialists alone are competent to engage, and who alone could derive benefit from such deliberations. Complete removal from the distractions of social life and large public gatherings, are conditions essential to success, and these conditions have been met in the past by placing the meetings at the time of the mid-winter recess when members could find a few days of relief from their professional work. So long as these conditions were observed, the work of the society was not only successful, but it commanded wide consideration and respect, and there was an atmosphere of enthusiasm and *esprit de corps* which made membership a thing to be sought for and valued.

The American Association has been accustomed from the time of its organization to hold its meetings in summer, usually the latter part of August or early September. In 1902, however, for reasons which we need not stop to analyze or discuss at this time, the association resolved to hold winter meetings, and to make these events synchronize with the meetings of the Naturalists. By many this unfortunate step was viewed with alarm, since they clearly perceived that there could never be room for two such bodies, occupying such distinct fields of endeavor, and with such distinctive methods and objects, in joint sessions, and that sooner or later there would be dissatisfaction and one must yield.

The American Association, by reason of its very constitution, must always remain distinct and apart from the Society of Naturalists. The two organizations occupy distinct spheres of usefulness which should not be compromised by being brought into too close contact, and it is well that this relation should not only be recognized but maintained, since in that way alone may they strengthen and supplement each other's work in the most effective manner. The great purpose of the American Association is to popularize scientific knowledge and effect its widest distribution. In this way it aims to secure for scientific men the widest recognition and the most perfect facilities for their work. It seeks, therefore, first of all, to gather about a relatively small nucleus of scientific men, the largest

possible popular membership collected from the population of the town or city in which its meetings may be held. No one would think of questioning the value of such a proceeding for the particular purposes of the association, but it will be readily admitted by all that such methods are not in harmony with the purely scientific spirit, that they are inconsistent with sober scientific thought, and that the meetings are not expected to be productive of the best results of investigation. Indeed, it is a matter of common repute that the meetings of the association are not the places for specialists to give serious attention to the problems they are endeavoring to solve, but rather that they afford convenient opportunities for cultivating the social side of scientific life. All this is eminently praiseworthy and desirable, but such work must not be confounded with or allowed to intrude upon opportunities for purely scientific deliberations.

Members of the Society of Naturalists are also in most, if not in all cases, likewise members of the American Association. In such joint membership there is nothing which need imply antagonism or duplication of work, but, on the contrary, such a perfectly natural relation should operate to the advancement of each, particularly of the latter association, by bringing to its ranks the very scientific strength it requires in the execution of its chief function—the popularization of scientific knowledge.

Since the institution of joint meetings there has been a growing feeling that it is impossible to do justice to both interests, that in the multiplicity of sections and societies, of meetings and social functions, there is left no opportunity for the sober work of the Naturalists which has, in consequence, resolved itself into a perfunctory discussion of some large problem of immediate interest. The most recent phase of this particular aspect of the question is found in the fact that other bodies are now entering this field and thereby tending to still further diminish the value of the work originally undertaken by the Naturalists, through useless duplication and dissipation of energy. The members feel that their time is not being occupied in the way they could wish; that they do not gain from their colleagues the interchange of ideas and experience they had hoped for. Under such circumstances dissatisfaction soon follows; fading enthusiasm treads hard upon the heels of fleeting ideals, and we shortly hear of moribund conditions; references to the greatness of the past and dismal forebodings for the future, coupled with the hope that the society may soon disband. These results must be regarded as the logical expression of forces set in motion when it was decided to establish joint sessions, since it has been observed that during the six years this relation has been in operation, there has been a gradual waning of interest in the public debates, which have also exhibited diminishing importance and force as the leading function of an important scientific body.

It is worth while to recall in this connection that the institution of joint sessions did not affect the Naturalists alone, but involved the Geological Society and all those specialists' societies in affiliation with the Naturalists. From these, complaints and protests are already beginning to be made, and I have it on the best of authority that at least one society is now considering what measures it shall adopt to counteract the undesirable situation in which it finds itself.

It is quite possible that a feeling of indifference or of complacency may have developed among a certain section of the society, and that in the annual house-cleaning which is supposed to take place with the installation of a new executive, there has not been sufficient removal of the waste

of previous years, and a proper introduction of that fresh atmosphere which brings with it renewed endeavor, a broader and more hopeful outlook and the inspiration to new activities and new conquests. I say this because we must be quite sure that neither the whole fault nor even a part of it lies with ourselves. But viewing the progress of events in the light of this qualification, as well as of the fact that we do not stand alone in our dilemma, the conviction is forced upon us that our difficult situation is primarily and chiefly due to the anomalous relations which have been established between us and the American Association. It appears to me, therefore, that while the general sentiment has forced conclusions based upon the alternative of a revision of our relations to that body or extinction, the real issue should be stated in terms of continued companionship. To my mind there should be no question of the society abandoning its chosen field of usefulness in which it has won such distinction. The issue is a clear one and should be won or lost on the simple question as to whether we shall continue to meet with the American Association or choose our own time and place.

Never in the history of the biological sciences, using that expression in its most comprehensive sense, have there been such rapid, extended and far-reaching changes, both of thought and method, as during the last twenty years, and without assuming the rôle of a prophet, it is probably safe to assert that the next two decades will witness even more profound changes. A society such as this, therefore, should always hold itself in readiness to adjust itself to altered conditions, and while exercising a due conservatism, it should, nevertheless, be prepared to meet the situation imposed by altered points of view, new methods, fresh hypotheses, newly ascertained facts and proved generalizations. In such ways alone does it become possible to infuse new life into those whose ripe experience may excuse a certain degree of complacency; or to awaken enthusiasm in those who are at the threshold of the richest experience that can fall to the lot of man.

Our last president indicated in his address before the society, that the changes introduced by abandoning the generalized methods of the old school of natural history for the more specialized methods of the new school of science introduced some thirty years ago, shortly led to a cleavage between the biological sciences which extended to a similar separation of geology and paleontology. That botany and zoology should become more independent was regarded as both natural and unavoidable, and, from many points of view, most desirable. Viewing the cleavage of paleontology from geology, from the standpoint of efficiency in scientific development, and the normal relations of cognate subjects, we need express no feelings of regret, for however valuable the evidence of fossil forms may be to the geologist as a working force, there is no natural relation between the two. It has, however, been a slow and somewhat tedious process to gain recognition of the fact that paleontology is not a science in itself, and that it does not bear any direct or precise relation to geology; but that it is a composite subject whose chief members belong to the domains of zoology and botany. Were the results of this cleavage to be expressed in no more extreme form than what has been indicated, they might be regarded with seeming indifference, but, as in all reforms, the swinging pendulum has been allowed to continue too far on its one-sided course, and for years the biological sciences have suffered an unsymmetrical development which at times has given rise to many heart burnings and false conceptions of what the science really stands for. The lingering tendency to per-

petuate a distinct scientific status for each of the older subjects, without reference to their cognate relations, has found expression in the recent attempt to organize an independent society for paleontology, a movement which I conceive to be unscientific in spirit, at variance with the present tendency of the times, and one which should receive the prompt discouragement of this and every other scientific body.

When Huxley and Martin introduced their meritorious scheme of general biology, they can hardly be said to have deliberately contemplated the absorption of the entire science of life by either the zoologist or the botanist, but, unfortunately, such was really the outcome of the forces set in motion by them. The relative conditions of development in zoology and botany in their day were such as to lead to the natural conception that a course in general biology must consist of a major quantity of the former and a minor quantity of the latter. This arose from the recognized fact that the development of zoology had proceeded along advanced lines for many years, while botany was yet struggling with questions of taxonomy, nomenclature and general morphology so-called—concerning itself but little with the more important aspects of the subject. It was not until twenty-five years ago that plant physiology, pathology, paleobotany and ecology began to attract attention, either as important educational subjects or as departments of research likely to be productive of great scientific or economic results. It would have been contrary to all human experience had the zoologists failed to promptly seize and exploit the rich fields which lay before them, and botanists have only themselves to thank for the fact that the zoologists not only appropriated their rich inheritance, but delayed a recognition of their rightful share until within the last decade. Gratifying as the present progress in this direction may be, it is nevertheless far from satisfactory. In many cases our best educational institutions show a lingering conception that botany plays only a subordinate part in any general biological scheme, and that biology is substantially a knowledge of animal life only. Professors even openly advocate courses, or persist in maintaining courses in general biology in which this feature is given special prominence. Among the general public highly educated people commonly discuss botany and biology as wholly distinct and largely unrelated subjects, a point of view for which we can make some allowance when their leaders in science ignore first principles. Such persistent, and one might almost say willful, blindness to the proper correlation of subjects begets a disastrous confusion of ideas and intellectual sterility. Witness the recent instance of a medical practitioner in good standing, and only a few years out of a leading medical school, expounding to a public audience the principles of preventive medicine as applied to tuberculosis. His advice was good, but when he left the immediate field of his own profession for that of science, his statement that "*Bacteria are little animals about half way between a spore and a seed*" was far from comforting to those who had fondly hoped some fertile soil was to be found in the ranks of the rising generation of medical men, wherein to sow the seeds of correct biological principles.

The recently exploited work of Mendel and the brilliant achievements of de Vries, whose results are now being utilized so extensively by zoologists in elucidation of hitherto obscure problems, the light thrown on general biological problems by the long and brilliant array of investigations in plant cytology, the advances in plant pathology which have led to results of the greatest economic importance and have thrown a brilliant side light upon many

obscure problems in animal pathology, recent progress in our knowledge of the laws of hybridization and inheritance, and a dawning recognition of the place which paleobotany properly occupies—all indicate not only that the subject of botany is rapidly gaining its rightful position, but that zoologists are becoming more and more dependent upon a knowledge of plants for a clear and rational explanation of many phenomena of animal life. I do not desire to leave the impression that zoologists as a whole are given to cultivating the erroneous ideas I have endeavored to indicate, because, as a matter of fact, there are many of our leading animal biologists who cheerfully and freely recognize the great and important position of botany as a channel through which some of the most important laws of life receive their best exposition. But that there is certainly need of reform with respect to the general attitude of both our educational bodies and the general public can not be questioned, and that this society should lend its influence in this direction I conceive to be among its most important functions.

The present tendency in science, received as a legitimate inheritance from the great upheaval of the latter part of the nineteenth century, is toward an undue specialization, and an undue haste to attain to the positions occupied by the older men of the professions. The introduction of the system of unrestricted options so fashionable a few years since, has led to efforts to specialize in the undergraduate course, a tendency which still receives far too much encouragement on the part of those whose experience and position should lead them to advise otherwise. My attention is more particularly directed to this with respect to the biological sciences for which a thorough grounding in chemistry, physics and geology is not only indispensable, but because such fundamental knowledge becomes more essential with every fresh advance that is made. The more deeply one specializes, the greater the need for that help which comes from other fields of learning. Plant physiology demands an accurate and somewhat extensive knowledge of both physics and chemistry. Pathology, to be profitable, must be studied from the comparative point of view. Paleobotany demands an extensive knowledge of geology. What is true of the science of plant life is more or less true of the sciences which deal with life in any one of its numerous phases. For the broad foundations in general science thus required, our educational institutions must provide opportunities for all-round and thorough training, and the present tendency to an early and undue specialization must yield, as it is already giving way to, a more rational group system. Above all, students must be brought to realize that a patient apprenticeship through which the successive steps are taken with deliberation and on the basis of thorough knowledge, is the only medium through which to secure the highest reward and the greatest satisfaction when the goal is finally attained.

Specialization, however, is not confined to individuals, but extends to societies and not only tends to lead them too far from the central idea of coordination, but involves an undue multiplication of organizations engaged in essentially the same lines of work. Such duplication is as unnecessary as it is deplorable.

Specialization is recognized as a necessity of modern scientific development, but its unrestricted exercise involves lack of coordination, narrowness of view, unsymmetrical development. While we fully agree with Dr. Farlow, as expressed in his presidential address before the American Association, that the object of scientific organization is to encourage diversity of work, he would undoubtedly agree with our point

of view that in exact proportion to such diversification or specialization, does it become of increasing importance that there should be a strong, centralizing power operating for breadth of view, coordination of results and a symmetrical development.

Under its present organization the Society of Naturalists is the coordinating and centralizing force for eight other societies which represent the work of specialists in their several fields of activity. These are: The American Anthropological Society, The Physiological Society, The Psychological Society, The American Society of Vertebrate Paleontologists, The American Society of Zoologists, The American Society of Anatomists, The Botanical Society of America, The Society of American Bacteriologists.

It would be a very fitting and natural association if to this important group there were added the Geological Society of America, whose deliberations involve so much in common with some of the other societies, and we may indulge the hope that such a union may be realized in the near future and be so extended as to embrace all of the other specialists' societies not represented at this time. With one or two exceptions this group may very well be regarded as an ideal division of activities without undue subdivision or duplication of work. The only ground for real criticism might be found in the separation of the vertebrate paleontologists from the zoologists, and of the bacteriologists from the botanists. With respect to the former I may reserve my remarks for another connection. With respect to the latter, it might seem better on general grounds that the bacteriologists should be merged with the botanists; but when it is recalled that membership includes many who are not botanists in the general acceptation of that term, that a large number are physicians and zoologists, and that bacteriology involves a peculiar and elaborate technique, almost exclusively applicable to these minute plants in their various economic relations, it must be conceded that here, at least, there are special reasons for a subdivision which, on other grounds, would not be justified.

It is obvious that specialization among societies may readily be carried too far—much beyond the bounds of scientific requirements. Among botanists this view has made great headway during the last ten years. Thus it is now generally agreed that a satisfactory knowledge and treatment of the science demands familiarity with the extinct forms of plant life, quite as much as with existing types. The methods involved in the study of fossil plants are essentially the same as those applied to the anatomy of recent plants. It is true that a certain and often detailed knowledge of geology is essential in this connection, but this does the botanist no harm and is more likely to be beneficial. The more we are called upon to deal with questions of phylogeny and evolution, the more essential does it become that fossil botany should be as familiar as recent botany. The two are, in fact, inseparable. It becomes clear, therefore, that it is an utterly false conception which endeavors to perpetuate the idea of a separate science of paleobotany. To encourage such a division is to retard the development of the science as a whole, and I am of the opinion that the remarks which apply to botany in this respect must also apply with equal force to paleozoology. No better service to the cause of consolidation, unification of interests and cooperation has been rendered in recent years, than by the union of the Society of Plant Morphology and Physiology and the Mycological Society of America, with the Botanical Society of America. These societies enjoyed separate existence for several years by reason of special circumstances which no longer exist. That the Botanical So-

ciety of America alone represents all the most important botanical interests of the country is a matter for congratulation.

Under the present system of joint meetings, or, as stated in the most recent official announcement, "under the scheme of affiliation" now in force, the following relations exist between the American Association and the Society of Naturalists, together with the various specialists' societies. Placing the latter in parallel columns with the former, it will be seen at a glance to what an extent there is duplication of work and a conflict of interests between the purely popular side and the purely scientific side.

AMERICAN ASSOCIATION	SOCIETY OF NATURALISTS
A—Mathematics and Astronomy	American Mathematical Society.
B—Physics	American Physical Society.
C—Chemistry	American Society of Biological Chemists. American Chemical Society.
D—Mechanical Science and Engineering.	. . . .
E—Geology and Geography	Geological Society of America. Association of American Geographers.
F—Zoology	Association of American Anatomists. American Society of Vertebrate Paleontologists. American Society of Zoologists. Entomological Society of America.
G—Botany	Botanical Society of America. Society of American Bacteriologists.
H—Anthropology and Psychology	The American Psychological Association. Southern Society for Philosophy and Psychology. American Anthropological Society. American Folk-Lore Society.
I—Social and Economic Science.	. . . .
K—Physiology and Experimental Medicine	Physiological Society.
L—Education.	. . . .
. . . .	American Philosophical Association.

The large number of specialists' societies here represented makes it clear that their separation from corresponding sections of the American Association for the Advancement of Science must be based upon the impossibility of properly conducting their work in such sections.

It is difficult to conceive what good purpose is served by announcing, let us say, that the American Physical Society will meet jointly with Section B (Physics) of the American Association. So far as the mere machinery of the meetings is concerned, there is an obvious saving of time and energy; but from the standpoint of scientific results, nothing can be gained for the simple reason that the majority of members of the Physical Society are also members of the American Association, Section B. From this it follows that the Physical Society would be simply meeting *with itself* while preserving the pleasing fiction that it was meeting with some other body.

Our analysis of the relations of the societies shows that there is not only an evident and unnecessary duplication, but that the work of one body interferes with that of the other; members often know not what meeting to attend; important papers are missed through unexpected changes of program and the impossibility of being in two places at once; confusion reigns supreme. It is clear that some radical and general readjustment of these relations is imperatively demanded in behalf of the general public whose interests are at stake, and for

the welfare of science, which is likely to suffer serious deterioration.

Apart from the considerations thus dealt with, there is another factor of great personal importance, since it bears directly upon the ability of the individual scientist to participate in the work of societies, and makes for the diminution of such organizations rather than their multiplication. In the pressure which is brought to bear upon the scientist to become a member of various societies, it is commonly overlooked that there is an absolute limit to his ability to meet the attendant expenses of such membership together with the ordinary requirements of his position and of his profession, and this limit is soon reached in the case of a large number of men. It was a recognition of this fact that led the Naturalists, some years since, to establish two branches, known as the Eastern and Western Branches, with such a form of organization as would enable them to meet separately or jointly as circumstances might determine. Few scientists are endowed with private means through either inheritance or marriage, and there are certainly several of the professions in which it would be impossible for them to amass even a moderate competency through the exercise of their technical knowledge.

Toronto, Chicago and Columbia have recently been enabled to advance their scale of salaries somewhat in accordance with the advance in the increased cost of living, but the great majority of institutions of learning adhere to the salaries which were barely adequate fifteen or twenty years ago. Taking the most common average salary at $2,000, an examination of the relations of a college professor to the responsibilities of his profession will probably justify the statement that he is called upon to expend from fifteen to twenty per cent. of his net earnings for the mere maintenance of his position without reference to the requirements of progress. "Low living and high thinking" finds neither place nor sympathizers under the present-day conditions, for he who would think high must not only be properly nourished, but his general environment must stimulate, not depress. We are in full accord with the attitude of a recent contributor to SCIENCE when he says:

> If we take $2,000 as the average salary of our college professors, we may say that on an average our professors will be drawn from homes where the scale of living is adjusted to the same figure. It should, therefore, be the aim of the college to pay such salaries to its professors as would enable them to give to their children what the college would regard as a perfect preparation for professional work. Only in this way can it draw its teachers from a class in which such preparation is possible.

The conditions indicated impose a grievous burden, and in the face of the education of children and support of families, it is often prohibitive of participation in those activities with which every scientific man should be identified. They carry with them also the additional burden of an undue strain upon the nervous system, and it is now a commonplace that the average professor is in a position of undue stress with respect to ways and means for the necessary expenses imposed by the position he holds, the maintenance of his family and the education of his children. It is within my own observation that this condition has more than once brought men to the verge of despair. It not only denies educated men of the very advantages they are expected to enjoy, but it places a premium upon celibacy and the imperfect education of children. These are not considerations in which sentiment forms a factor, but elements which are directly concerned in the best social organization. But, wholly apart from purely personal elements, putting the case upon the ground of correct business principles and business expediency, we may

safely ask if it is good business policy to engage the services of a highly trained man, impose upon him the most exacting physical and mental labor, and at the same time place him under conditions which compel him to expend from twenty-five to fifty per cent. of his nervous energy in attempts to meet situations altogether foreign to his professional work?

A confirmation of these views comes to us in a wholly unexpected manner through the death, on the twelfth of November last, of one of the most distinguished zoologists of the world. A man of singular modesty but charming personality, he saw in the needs of the younger generation demands which rose superior to all personal considerations. The story comes to us that much needed rest from most exacting labors was refused in the interests of his children. Who will dare say that we have not in this picture an exhibition of the highest type of noble self-sacrifice, and who is in a position to deny that he might yet be with us and prosecuting his work, had he been granted that pecuniary recognition which would have given him an opportunity for the proper care of his children without unnecessary hardship?

If the Society of Naturalists could lend its influence in the direction of an improved public appreciation of the services of the college professor, the real relation he bears to advancement in all departments of intellectual and industrial life, and a proper financial recognition of his services, it would confer upon society at large a benefit for which an adequate standard is difficult to find.

But I must hasten to direct your attention to the problem which demands immediate consideration, "How to find a remedy for the difficult situation in which the society is now placed?"

As the result of a very careful consideration at the hands of your executive body, and after obtaining a wide expression of views and some detailed plans, a proposition has been formulated which may serve as the basis of action by the society as a whole.

The general sentiment appears adverse to maintaining the society as a mere holding body. This opinion correctly indicates that the society must have some broader and higher function than that implied by an annual banquet and a public discussion. The various affiliated societies must be led to feel that there is a living force which brings them into harmonious relations with all kindred societies; that the central organization deals with the larger and broader questions in a spirit of coordination and in a way not possible to those engaged in the pursuit of specialties; that it lends its active influence in the promotion of research; that it is alive to the interests of the scientific professions, and that it has regard to problems of broad policy—in a word, that it is a living bond which makes for solidarity, community of interests, enthusiasm. The society should not only concern itself with the progress of science, but it is quite as much within its province to have regard for what may be called the economics of the scientific professions—the various conditions which affect the status, welfare and capacity of the individual.

In view of the overshadowing influence which larger and more popular bodies must necessarily exert, it is proposed that, hereafter, the meetings of the Naturalists shall remain independent of other general societies. This does not exclude the use of convocation week, but it does imply that we shall henceforth select some other time and place of meeting than that chosen by any society of a general and more or less popular character.

The present relations of specialists' societies to the Society of Naturalists is satisfactory in principle, though in practise

ways and means may be found to make it more advantageous to all than in the past. It is believed that under the proposed reorganization, it would be highly advantageous to include in the general scheme of affiliation all specialists' societies whose standard of membership is sufficiently high to conform to the requirements of the Society of Naturalists.

To further identify our interests with those of the specialists' societies, it is proposed that all matters of cooperation shall be dealt with by the executive committee, which shall be selected with a view to the establishment of such external relations. This phrase might well be interpreted to mean that each affiliated society shall have its chosen representative on the executive committee of the Naturalists, thereby ensuring the only relation between the several societies through which it will be possible to secure solidarity and identity of interests through cooperation.

It is designed to redefine the general policy in such a manner as to readjust it more definitely to the encouragement of research in the larger fields of science. It should be one of the first objects of our most earnest endeavor to secure a permanent fund which should be devoted to the encouragement of research by any properly qualified investigator within the limits of the United States and Canada, but the subject of investigation should fall within the field occupied by one of the affiliated societies.

The central idea of the society should find expression in some one line of endeavor which makes for the general progress of scientific thought. Of all the societies enumerated, which may be fittingly associated with the Naturalists, there is not one whose work may not be regarded as comprised in general biology, or as having an important collateral bearing upon that science. Whether expressed through the medium of the botanist, zoologist, physiologist or anatomist; through the more indirect channel of the anthropologist and the folklorist; or through the yet less direct channel of the chemist, the geologist or the physicist, the development of the earth, organic life and even thought itself, is the underlying motive for all. Evolution is, therefore, a great central idea which appeals to all investigators of natural phenomena, and this subject is suggested as one which should be the chief endeavor of the parent body.

In order to give working effect to this idea, it is proposed that each year original contributions dealing with one or more aspects of evolution should be presented to one or more meetings of the Society of Naturalists. Furthermore, it is regarded as desirable that there should be a presentation, annually, of reports upon the most important of recent works dealing with evolution. Both reports and the special contributions should be entrusted to men eminent in their respective fields of research. To occupy a position of this kind should imply a compliment.

It is believed that a general policy, wisely carried out, which keeps alive the enthusiasm for research in the ways indicated, would not only constitute a strong bond of union between the members of the entire organization, making for solidarity of interests, but that it would enlist the sympathy and cooperation of the younger generation of scientists.

D. P. Penhallow

McGill University

GEORGE WASHINGTON HOUGH

On New Year's morning, at about ten o'clock, occurred the sudden and unexpected death of Dr. George W. Hough, director of the Dearborn Observatory, at Evanston, Ill. Death came suddenly and painlessly to him, in the way that he had always hoped for it,

after he had come to fulness of years without any break in his intellectual vigor.

He was born at Tribes Hill, N. Y., on October 24, 1836. His ancestors on both sides were German, and old settlers in the Mohawk Valley, the first Hough having come to this country in 1730 from Würtemburg.

Professor Hough was a born astronomer, and grew up filled with the idea of following that profession; it is said that at nine years of age he constructed a contrivance from fish-poles for measuring the right ascension of a star. His mechanical genius, which he inherited from his father, also became manifest about this time, and he harnessed up a small brook to do his mother's churning.

After completing the course in the graded schools and the Seneca Falls Academy, he entered Union College at Schenectady, N. Y., where he graduated in 1856 with high honors.

After graduation he became principal of the first ward school in Dubuque, Iowa, where he remained until 1858, when he entered Harvard University for post-graduate work, taking the degree of A.M. in 1859. The same year he became assistant astronomer at the Cincinnati Observatory.

In 1860 he went to the Dudley Observatory at Albany, N. Y., as assistant astronomer, and two years later was appointed director, which position he held until 1874. It was at the Dudley Observatory that a large amount of his valuable work was done.

His astronomical work consisted largely in the observations of the declination of stars compared with Mars, observations of the planet Neptune, and of asteroids, and observation of Nautical Almanac stars, standard zone stars and small planets.

He invented at this time a machine for cataloguing and charting stars, the principle of which depends on the magnifying by mechanical means the angular motion of the telescope.

In 1867 he began work on the measurement of Struve's list of close double stars, and during the same year made a long series of investigations to determine the amount of the personal equation in transit observations. He made, besides, valuable observations on the rate of the sidereal clock, and the compensation of the pendulum.

A large part of his time and attention at the Dudley Observatory was given to meteorological work, and in 1865 he invented his recording and printing barometer. The principle of this instrument consists in the transmission of changes in the level of the mercury, by a float resting on the surface of the mercury in the short arm of a syphon barometer. The movements of the float are transmitted by electricity to the moving parts of the mechanism, which repeat this motion and record it. His reports show that more than 50,000 barometer observations were made with this machine in five years. He was awarded a gold medal for this instrument at the Centennial Exhibition in Philadelphia in 1876, and many years later he received a medal for the same instrument at the World's Fair in Chicago in 1893.

Another machine invented at this time was the meteorograph, a machine of simpler construction, which registered hourly the barometer and wet-and-dry-bulb thermometers. Several of the two machines mentioned above were constructed for the United States government.

He also invented an automatic anemometer, which records the velocity of the wind in the form of a curve, prints the results hourly in miles, and also gives the direction, electricity being used as the active agent. He published a long series of observations made with this machine, and was one of the first to point out the intimate connection between atmospheric pressure and the direction of the wind.

Besides these instruments, he invented the first horizontally-driven machine-saw, and also began work on his printing chronograph. He was an expert mechanic, and did all the work on his machines with his own hands.

In 1868 he made a long series of investigations on the Daniel or gravity battery, and was the first to show that lead may be advantageously substituted for copper as the negative plate. He also showed that the substitution of a cell of leather 0.06 inch thick in place of the porous clay cell in the battery produced double the amount of current. Moreover, that the quantity of electricity

flowing in the external circuit depends on the specific gravity of the zinc sulphate, and that polarization in the battery is caused by the saturation of the zinc sulphate.

He made important investigations concerning the velocity of the electric current, and showed that the apparent velocity is directly proportional to the magnetic force of the circuit, but the real velocity can not be measured.

In 1869 he was chief of an expedition of astronomers sent to Matoon, Ill., to observe the total eclipse of the sun.

In 1870 he was married to Emma C. Shear, daughter of Jacob H. Shear, of Albany, N. Y.

He was elected an honorary member of the German Astronomical Society in 1871. Almost from the beginning of his professional career he took an active part in the meetings of the American Association for the Advancement of Science, and was at one time vice-president.

In the year 1879 he was appointed director of the Dearborn Observatory at Chicago and professor of astronomy in the old Chicago University. His work at once brought Dearborn Observatory into special prominence among the leading observatories of the world.

It was then that he began his systematic study of the planet Jupiter, and this series of observations was continued without interruption for thirty years till the time of his death. These observations included a careful study by micrometer measurements of all the jovian phenomena, especially of the great red spot and the equatorial belts, and made Professor Hough justly famous in the latter days of his life as the greatest authority for that planet. The details and results of these investigations are to be found in the various annual reports of the Chicago Astronomical Society, and in numerous pamphlets published after he came to Evanston.

He also made observations of the satellites of Uranus, and discovered a few new nebulæ. During the first few years in Chicago he was associated in his work with Professor Colbert and Professor Burnham.

In 1882 he took up the study of difficult double stars, and is credited with having discovered over 600 pairs, most of them beyond the reach of any but the most powerful telescopes, which gave him the distinction of having discovered more double stars than any other astronomer of his time.

While in Chicago he perfected his printing chronograph, an instrument which is coming into general use in observatories. He also invented an observing seat for the equatorial, which has been adopted by all the leading observatories.

He became interested in the Chicago Academy of Sciences, and served one term as vice-president of that institution.

In 1887 the Dearborn Observatory was moved to Evanston and became part of the Northwestern University. Professor Hough came with it as director, and as professor of astronomy in Northwestern University. During his twenty-one years' residence in Evanston he accomplished a large part of his important work on Jupiter and double stars.

In 1888 he invented a new astronomical dome, superior to anything else of the kind. His inventions here include an absolute sensitometer for testing photographic plates in various kinds of light, an electrical control for the equatorial, an improved form of storage battery combining durability and low cost, a transmission dynamometer for use with the electric motor, and a new and improved form of photographic plate-holder.

In 1891 he received the honorary degree of doctor of laws from Union College, and about the same time was elected a member of the British Astronomical Association. At the World's Congress in Chicago in 1893 he was president of the mathematical and astronomical section. In 1903 he was elected an associate member of the Royal Astronomical Society of England. He was also a member of the Astronomical Society of the Pacific, the Astronomical and Astrophysical Society, the American Philosophical Society, the American Institute of Civics, the Chicago Photographic Society and the Trinity Historical Society of Texas, and at one time a member of the Albany Institute, the Chicago Lantern Slide Club and the Chicago Electrical Society.

In character Professor Hough was quiet

and unassuming, but of an affectionate, genial disposition, and was greatly beloved by all who knew him. His learning and knowledge were vast, and very wide in their scope. He never spoke hastily nor too much, and his opinion on a subject was always worth having. In my long association with him I have often felt the truth of Emerson's words: "Converse with a mind that is grandly simple, and literature looks like word catching."

The sudden death of this great and good man came as an irreparable loss not only to the community but to the whole scientific world.

GEORGE J. HOUGH

DINNER TO PROFESSOR RAMSAY WRIGHT

THE old pupils and colleagues of Professor Ramsay Wright, of the University of Toronto, joined in celebrating the completion of his thirty-fifth year of service in the university by tendering him a complimentary banquet and address on April 15. The chair was taken by Professor J. Playfair McMurrich, the toast to the university was proposed by Professor F. R. Lillie, of the University of Chicago, that to the guest of the evening by Dr. T. MacCrae, of the Johns Hopkins University, and the address was presented by Professor A. B. Macallum. A number of letters from distinguished colleagues of other universities were read, all of which bore ample testimony to the value of the services rendered by Professor Wright in the development of the biological sciences in Canada, in the elevation of the standards of medical education and in the constant maintenance, both by example and precept, of the highest ideals of scholarly attainments. A pleasing incident of the banquet was the reading of a Latin ode composed for the occasion by Professor Maurice Hutton, and of a sonnet by Professor W. H. Ellis, which follows:

From Scotland's mists across the sea you bore
 The sacred fire (kindled by him whose name
 Has made the century famous with his fame),
And bid our lamp burn brighter than before.
Upon our tree, a branch from Scotland's shore
 You grafted, and behold, our tree became
 Wanton in leafage; with blossoms all aflame;
Deep rooted; and with boughs to heaven that soar.
We see the better issue from the strife,
 And hope the best. In loathsome crawling things
 We feel the fluttering of jeweled wings.
In nature's score, with seeming discords rife,
 We seek to read, with you, the note that brings
To harmony the jarring chords of life.

THE SHAW SCHOOL OF BOTANY

THE recently issued administrative report of the Missouri Botanical Garden, and an announcement of Washington University concerning the Henry Shaw School of Botany, indicate that the Shaw foundation is on the eve of entering upon a much increased activity. Although Henry Shaw in 1885 endowed a school of botany in Washington University, to the head of which Professor Trelease was called from the University of Wisconsin, the provision made was practically for only a chair of botany. Four years later, on the death of Mr. Shaw, his fortune, appraised at several million dollars, passed to the care of trustees, for the maintenance of his long established and well known garden and the further development of an institution of research and instruction in botany and allied sciences; the head of the School of Botany being selected as its director.

In the twenty years that have since passed, the trustees of the Shaw estate have been compelled to administer their trust on a maintenance basis, seeing approximately a quarter of their gross income absorbed in general taxes and nearly as much more claimed for street improvements, sewers and similar purposes, a large part of which were entailed by the possession of extensive tracts of unimproved real estate within the city limits. Meantime, the revenue of the School of Botany has sufficed for scarcely more than meeting the undergraduate needs of the university. Nevertheless, maintenance of the garden has been made to include the provision of a good equipment in living plants (11,464 forms), herbarium (618,872 specimens) and library (58,538 books and pamphlets). A part of the time of otherwise indispensable employees has been given to botanical investigation, the results of which are published in a series of annual reports begun in 1890,

and fifteen graduate degrees have been earned in the School of Botany.

Though a continuation of high special taxes is anticipated for the next few years, the trustees of the garden hope to see the end of this burden before a great while, and in co-operation with the university authorities they are now prepared to make larger research use of the equipment on hand and begin to provide for graduate instruction to a greater extent than has been possible heretofore. Last year a well designed fireproof building of about 12,000 square feet of floor space was put up. A part of this is being furnished in steel for stack purposes, and the remaining—and larger—part is being equipped for laboratory use. It is now announced that a definite step toward the fuller development contemplated by the founder and planned by the director has been taken in the establishment of the post of plant physiologist at the garden, and the creation of a professorship of plant physiology and applied botany in the Shaw School of Botany, with provision for two research fellowships in botany: in addition to the Englemann professorship held by Dr. Trelease, the assistant professorship held by Dr. Coulter, a teaching fellowship to which Mr. C. D. Learn has recently been appointed, and the honorary post of plant pathologist at the garden held by Dr. von Schrenk.

With this equipment and staff, which are to be gradually increased and are likely to be much enlarged in the near future, it is intended to develop research and graduate instruction and to establish in the broadest sense a course in applied botany, in addition to giving the undergraduate instruction needed in Washington University.

To the new professorship, Dr. George T. Moore has been called, as possessing to an unusual extent the desired combination of established reputation, breadth of view and expert appreciation of the economic applications of botany. The research fellowships are open to capable graduate students from any college, and are believed to offer unusual opportunities for the productive use of talent in investigation. The library, herbarium, and garden furnish the necessary facilities for the most advanced investigation, and the work in the School of Botany is to be so planned that the individual needs of students engaging in research will be met in every way possible, while leading to the customary degrees.

SCIENTIFIC NOTES AND NEWS

THE following new members of the National Academy of Sciences were elected at the meeting on April 22, 1909: Professor Joseph S. Ames, Johns Hopkins University; Professor Maxime Bôcher, Harvard University; Professor Oskar Bolza, University of Chicago; Mr. Frank W. Clarke, U. S. Geological Survey; Dr. John M. Clarke, New York State Museum; Professor John M. Coulter, University of Chicago; Professor Henry Crew, Northwestern University; Professor Thomas Hunt Morgan, Columbia University; Mr. Waldemar Lindgren, U. S. Geological Survey; Professor Henry L. Wheeler, Yale University. The following were elected foreign associates: Professor Albrecht Penck, University of Berlin; Professor Gustaf Retzius, Stockholm; Professor Wilhelm Waldeyer, University of Berlin; Professor Wilhelm Wundt, University of Leipzig.

DR. ARRIGO TAMMASSIA, professor of forensic medicine in the University of Padua, has been created by the king of Italy a senator of the kingdom.

PROFESSOR G. LUNGE, of Zurich, has been elected an honorary member of the London Chemical Society.

THE founder's medal of the Royal Geographical Society has been awarded to Dr. Stein for his archeological and geographical explorations in Central Asia. The patron's medal has been awarded to Colonel Talbot for his surveys on the northwest frontier of India and in the Anglo-Egyptian Sudan.

ST. ANDREWS UNIVERSITY has conferred its doctorate of laws on Dr. James Wallace, F.R.S., professor of chemistry in University of Edinburgh.

DR. GEORGE LINCOLN GOODALE, professor of botany at Harvard University since 1878, will retire from active service at the close of the present academic year. Professor Goodale

will celebrate his seventieth birthday on August 3.

Dr. F. Zirkel, professor of mineralogy at Leipzig, has retired from active service.

Dr. William W. Cadbury has resigned as pathologist in the Henry Phipps Institute, Philadelphia, and sailed for China, where he will aid in the establishment of a University Medical School in Canton.

Mr. D. L. Van Dine, who has been the entomologist of the Hawaii Agricultural Experiment Station for the past seven years, has accepted a position in the Bureau of Entomology at Washington. His work will be on the insects affecting sugar cane and rice in the southern states.

At the meeting of the Board of Directors of the Rockefeller Institute for Medical Research, held on April 10, the following promotions and appointments were made:

Associate Members—John Auer (Physiology), Hideyo Noguchi (Pathology), Alexis Carrel (Surgery).

Associate—George W. Heimrod (Chemistry).

Assistants—Martha Wollstein (Pathology), Richard V. Lamar (Pathology), A. O. Shaklee (Physiology), Gustave M. Meyer (Chemistry).

Fellows—M. T. Burrows (Pathology), Paul F. Clark (Bacteriology).

Professor H. G. van de Sande Bakhuyzen has retired from the directorship of the Leyden Observatory and is succeeded by Mr. E. F. van de Sande Bakhuyzen.

Dr. Max Wolf has been appointed director of the University at Heidelberg in succession to Dr. Wilhelm Valentiner, who has retired owing to ill health.

Dr. Ernst Küster, of Halle, has been appointed keeper in the Botanical Institute and Garden at Kiel.

Dr. S. Squire Sprigge has accepted the editorship of the *Lancet.*

The State Department has approved the attendance of the following as American delegates at the International Congress of Applied Chemistry to be held in London next month: Dr. Harvey W. Wiley, chief of the Bureau of Chemistry of the Department of Agriculture; Dr. Allerton S. Cushman, of the same department; Dr. Frank Wigglesworth Clarke, of the U. S. Geological Survey; Dr. Charles Baskerville, professor of chemistry at the City of New York College; Drs. William H. Nichols, Maximilian Toch, Herbert Plaut and Morris Loeb, of New York; Dr. William L. Dudley, of Vanderbilt University, and Dr. L. H. Baekeland, of Yonkers, N. Y.

Dr. Raymond L. Ditmars, curator of reptiles in the New York Zoological Park, sailed for Europe on May 8 to visit the Zoological Gardens and arrange for the exchange of animals.

Professor F. L. Stevens, of the North Carolina Station and College, will during this vacation visit the leading agricultural experiment stations and agricultural colleges of Europe, particularly those experiment stations engaged in work in plant disease or soil bacteriology.

Professor William Osler, of Oxford, is paying a visit to the United States and Canada. He expects to return to England on July 1.

Dr. Stelberg, accompanied by Dr. de Quervain and Dr. Balber, has been sent by the Danish government on a scientific expedition to Greenland.

Dr. Skottsberg, the Swedish explorer, has returned from an expedition to southern Patagonia.

Mr. Douglas Carruthers has returned from a natural history exploration in the unknown parts of central Arabia.

It is announced in the English journals that Dr. W. Bruce, of the Scottish Oceanographical Laboratory, has made more detailed plans of another Antarctic expedition to leave in 1911, the cost of which is estimated at £50,000. It is proposed to carry on extensive oceanographical work in the South Atlantic Ocean between and south of Buenos Ayres and Cape Town, as well as in the Weddell and Biscoe Seas; to map the coast-line of Antarctica to the east and west of Coats Land, and to investigate the interior of Antarctica in that longitude. Part of the project includes a journey across the Antarctic continent, starting at some suitable base in the

vicinity of Coats Land and emerging at McMurdo Bay, Victoria Land or King Edward Land. The program includes a circumpolar bathymetrical survey, especially in relation to the study of former continental connections. Mr. C. E. Borchgrevink will also conduct a new expedition to South Polar regions. The expedition, the financial and other details of which have already been settled, has been arranged under the auspices of the International Polar Exploration Commission at Brussels.

A PARTY sent by the government to investigate the circumstances connected with the murder by Ilongote tribesmen of Dr. William Jones, of the Field Museum of Natural History, Chicago, has recovered the valuable collection made during the past two years.

AT the 665th meeting of the Philosophical Society of Washington, held on April 26, Professor Max Planck, of Berlin, gave a lecture entitled "Die Mechanik als Grundlage der Physik," complimentary to the American Physical Society.

MR. J. G. JACK will conduct a Field Class at the Arnold Arboretum, Harvard University, on Saturdays during the spring and early summer, to assist those who wish to gain a more intimate knowledge of the native and foreign trees and shrubs which grow in New England.

PROFESSOR BASKERVILLE announces a course of lectures by eight or ten recognized experts in the City of New York upon such subjects as water supply, sewage, gas, storage of combustibles, food adulteration, etc.

THE Sioux City Academy of Sciences held its annual meeting on April 13. Its program was devoted to a Darwin memorial which was as follows:

"The Biography of Charles Darwin," Professor H. C. Powers.

"Charles Darwin and the Theory of Natural Selection," Rev. Manley B. Townsend.

"The Principle of Natural Selection as Applied in Education," Professor E. A. Brown.

"A Philosophy Out of Darwin," Rev. Ralph P. Smith.

PROFESSOR F. W. MOTT, F.R.S., began on April 20 a course of two lectures at the Royal Institution on "The Brain in Relation to Right-handedness and Speech." On April 24 Mr. R. T. Günther began a course of two lectures on "The Earth Movements of the Italian Coast, and their Effects." The Friday evening discourse on April 23 was delivered by Mr. Alexander Siemens on "Tantalum and its Industrial Applications."

HENRY AUGUST HUNICKE, formerly professor of chemistry in Washington University, and later chemist for the Anheuser-Busch Brewing Association and a practising chemical engineer, died at St. Louis on April 5 at the age of forty-eight years.

ALBERT B. PORTER, for ten years professor of physics at the Armour Institute, Chicago, and later engaged in the manufacture of scientific instruments, died on April 17, at the age of forty-three years.

MR. FREDERICK KATO, who was interested in mineralogy, died of pneumonia in his home on Jersey City Heights on April 20, at the age of forty-three years.

DR. FRITZ ROEMER, director of the Senckenberg Museum of Natural History at Frankfort, has died at the age of forty-two years.

AT the meeting of the American Philosophical Society in Philadelphia on April 22, Mr. Edwin Swift Balch presented the following resolution which was passed unanimously:

WHEREAS, The United States in former years made many brilliant discoveries in the Antarctic, including the continent of Antarctica by Charles Wilkes, and

WHEREAS, The United States have not taken any part in the recent scientific explorations of the South Polar regions;

Resolved, That the American Philosophical Society requests the cooperation of the scientific and geographical societies of the United States, to urge on the United States Navy and the general government, that it do make sufficient appropriations to fit a government vessel to thoroughly explore and survey the coast of Wilkes Land, and other parts of Antarctica.

BY recent act of the legislature provision has been made for a biological station to be located on the shores of Devil's Lake, North Dakota. An appropriation has been made for building laboratories and providing annual

maintenance. This laboratory will be fortunately situated for the study of many interesting ecological and physiological problems, inasmuch as Devil's Lake is a large body of brackish water with no outlet and represents the collected water supply of a large interior drainage basin. The direction of this laboratory will be under the charge of the biological department of the State University, of which Professor Melvin A. Brannon is head.

The fifteenth general meeting of the American Electrochemical Society will be held at Niagara Falls, Canada, on May 6, 7 and 8. The retiring president, Mr. E. G. Acheson, has chosen as the subject of his address "The Electrochemist and the Conservation of Our National Resources." The program includes a symposium on "The Electrometallurgy of Iron and Steel," to include eleven papers.

The New York Botanical Garden offers the following prizes for essays not exceeding 5,000 words, from the income of the Caroline and Olivia E. Stokes Fund for the Preservation of Native Plants: (1) $40, (2) $25, (3) $15. Essays must be typewritten in duplicate and must reach the garden not later than June 20, 1909.

King Leopold, of Belgium, has decided to grant a prize of $5,000 to the author of the best work answering the following question: "Describe the progress of aerial navigation and the best means to encourage it." All essays or works relative to the subject and competing for the prize must be sent to the minister of science and arts in Brussels before March 1, 1911. The competition is open to all nationalities. No new edition of any work already in print will be admitted to this competition unless it comprises thorough changes and considerable additions. In case certain sections of any work or essay on the subject have already been published, such work or essay may still be able to enter in this competition providing the last part is published during the time allotted for the competition. The jury will comprize three Belgians and four foreign members. No member of the jury will be allowed to send any work or essay to the competition. The manuscript, work or essay winning the prize must be published during the year following the one in which the prize will be awarded. Competitors may use French, English, Flemish, German, Italian, Spanish or Portuguese.

The Hampstead Scientific Society has under consideration a proposal to establish an astronomical observatory and meteorological station on the reservoir near the summit of Hampstead Heath, London. It is proposed to rent, at a nominal charge, a portion of the top of the reservoir near the Whitestone Pond, to build there an observatory house, and to erect the eight-inch reflecting telescope, equatorially mounted, by Grubb, presented to the society some two years ago by Dr. F. Womack; and to establish on the same area a meteorological station, equipped as a "Normal Climatological Station" under the regulations of the Meteorological Office.

Arrangements have been made by Professor Foerster, of the University of Berlin, to republish in German an abstract of the documents of the American Association for International Conciliation. Separate articles by Mr. Elihu Root, Mr. Andrew Carnegie, Professor Ladd, of Yale, and Professor Rowe, of the University of Pennsylvania, have been translated into foreign languages, but this is the first arrangement for a general translation and republication.

The Appalachian Engineering Association will meet in Roanoke, Va., on Saturday, May 8, when the following papers will be read:

"Lead and Zinc Ores in Wythe and Pulaski Counties," by Mr. M. M. Caldwell, of Roanoke.

"Organization and Engineering Difficulties of the Virginian Railway," by Major William N. Page, of Washington, D. C.

"The Virgilina Copper District," by Dr. Thomas L. Watson, State Geologist of Virginia, and Professor of Economic Geology, University of Virginia.

"Geologic Engineering Code of Ethics," by Captain Baird Halberstadt, of Pottsville, Pa.

"Properties and Uses of Mineral Gypsum," by Dr. Frank A. Wilder, of North Holston, Va., ex-State Geologist of Iowa.

The meeting will be followed on Saturday evening by a banquet for the association

and invited guests, tendered by the Chamber of Commerce of Roanoke.

The fourth annual meeting of the Oregon State Academy of Sciences was held at the High School, Salem, on February 19 and 20, with the following program:

President's Annual Address, A. R. Sweetser.

Illustrated Lecture on Birds, Wm. L. Finley.

"Some Perplexing Problems in the Most Complex of the Sciences," Gaylard H. Patterson.

"Disturbance of Embryonic Nutrition," Ernest Barton.

"The Mineral World," W. A. Miller.

"Some Hymenoptera," C. E. Bridwell.

"The Sea Side Laboratory at Friday Harbor" (illustrated), C. O. Chambers.

"The Kinetic Theory of Matter," B. C. Eastham.

"Denatured Alcohol," C. E. Bradley.

"Problems in Sex Determination," J. F. Bovard.

The National Association for the Prevention of Consumption has arranged to hold a tuberculosis exhibition at the Art Gallery, High Street, Whitechapel, London. The exhibition will illustrate the extent, cause, spread, prevention and cure of tuberculosis, and will have a special section devoted to tuberculosis in children. It is expected that the exhibition will be opened by the President of the Local Government Board on June 2, and it is proposed that after it has been shown in London it should be taken to various provincial cities and towns.

UNIVERSITY AND EDUCATIONAL NEWS

A board of education has been established in Iowa to control the State University, the State College of Agriculture and the Mechanic Arts and the State Normal School. The board is to consist of nine members, appointed by the governor, and confirmed by the senate, five to be republicans and four democrats. The members of the board serve for six years, one third retiring every two years. The board is to elect a finance committee, of three members, from without its own membership. These three men are to give their entire time to the business management of the institutions, and are to receive salaries of $3,500 a year.

The twelfth conference for education in the south was held in Atlanta, Ga., April 14 to 17. The conference, while discussing general educational subjects, was devoted especially to the improvement of conditions in the open country. The president, Mr. Robert C. Ogden, of New York, gave an address, and the program included addresses on "The American Spirit in Education," by Dr. S. C. Mitchell, the newly elected president of the University of South Carolina; "The National Program in Education," by Dr. Elmer Ellsworth Brown, U. S. Commissioner of Education; "How the National Government may cooperate with the States in Bettering Conditions in the Open Country," by Mr. Gifford Pinchot, of the Forest Service, Washington.

Dr. W. F. Dearborn, assistant professor of educational psychology in the University of Wisconsin, has resigned to take a similar position in the University of Chicago. Dr. B. H. Bode, assistant professor of philosophy in the University of Wisconsin, has resigned to accept a professorship in the University of Illinois.

Dr. Edmund Landau, of Berlin, has been called to a professorship of mathematics at Göttingen.

Dr. Herman Kobold has been called from Kiel, to a professorship of astronomy at Berlin.

M. Paul Langevin has been appointed professor of physics in the Collège de France, as successor of the late M. Mascart.

DISCUSSION AND CORRESPONDENCE

ON GENERIC NAMES

In a recent issue of Science, Dr. Hubert Lyman Clark has done good service in deprecating the too familiar practise of naming species after (commonly insignificant) persons. While not a systematic zoologist *sensu stricto* myself, I have had occasion to consult taxonomic works quite extensively for a number of years past, and I am therefore in a position to appreciate the force of Dr. Clark's criticisms. It is my object here to extend their application a little, so as to cover generic names as well. It appears to me that for these last the objection holds with even greater force, since the genus is, theoretically, at

least,[1] a larger category than the species. It is true that we have high precedent for naming genera after persons, as witness the genus *Linnæa*, named for the great master himself by one of his contemporaries. And we have become so accustomed to *Fuchsia* and *Wistaria* that we scarcely ever give thought to their derivation. But what shall we say of *Montagua, Grantia, Perkinsia, Fitzroya, Kellia, Mitchillina, Smithia, Jonesia*, etc.? These were all, no doubt, estimable gentlemen who did their share of the world's work; but are their names commanding enough (to say nothing of euphony!) to deserve perpetuation in scientific literature? And if we should take into consideration the question of euphony, what would become of such genera as *Billingsella, Girardinichthys, Pilsbryoconcha* and *Tarletonbeania*,[2] or of *Kohlera* and *Dyaria*?[3] Any systematist could add indefinitely to this list.

Loyalty to one's friends is a commendable trait, even in a man of science; and a sense of humor is possibly the only thing that saves most of us from suicide or insanity. But there is a time and place for all things. One assumes a grave responsibility in inflicting upon future generations[4] such philological abortions as those to which I have been alluding.

FRANCIS B. SUMNER

WOODS HOLE, MASS.,
March 31, 1909

[1] This qualification is inserted in view of the growing custom of creating a separate genus to contain each species.

[2] This should have been *Tarleton-H-Beania*. Dr. Bean is plainly entitled to damages.

[3] This last I have on hearsay, but it is far from incredible.

[4] This is confessedly a bit of rhetorical exaggeration. A taxonomic name does not generally endure over five years, if, indeed, it is fortunate enough to be overlooked for so long a period.

A MENDELIAN VIEW OF SEX-HEREDITY; A CORRECTION

TO THE EDITOR OF SCIENCE: My attention has been called to the fact that in a recent article on sex-heredity published in SCIENCE, March 5, 1909, I carelessly wrote *lugens* for *lacticolor*, on pages 399 and 400, when referring to the pale variety of *Abraxas grossulariata*.

W. E. CASTLE

March 31, 1909

BIOGRAPHICAL DIRECTORY OF AMERICAN MEN OF SCIENCE

THE undersigned will print as soon as the compilation can be made, a second edition of the *Biographical Directory of American Men of Science*. The work is intended to be a contribution to the organization of science in America, and the editor will greatly appreciate the assistance of scientific men in making its contents accurate and complete. Those whose biographies appear in the first edition are requested to forward such alterations and additions as may be necessary or desirable, and to obtain biographical sketches from those who should be included. All those engaged in scientific work whose biographies are not included in the first edition are requested to send the information needed, using, for this purpose the blank that is given on an advertising page (vii) of the current issue of SCIENCE.

It is intended that each entry shall contain information as follows:

1. The full name with title and mail address, the part of the name ordinarily omitted in correspondence being in parentheses.
2. The department of investigation given in italics.
3. The place and date of birth.
4. Education and degrees, including honorary degrees.
5. Positions with dates, the present position being given in italics.
6. Temporary and minor positions; scientific awards and honors.
7. Membership in scientific and learned societies with offices held.
8. Chief subjects of research, those accomplished being separated by a dash from those in progress.

All those in North America should be included in the book who have made contributions to the natural and exact sciences. The standards are expected to be about the same as those of fellowship in the American Association for the Advancement of Science or

membership in the national scientific societies which require research work as a qualification.

The compilation of the new edition will of necessity involve much labor, but this will be materially lightened if men of science will reply promptly to this request.

J. McKeen Cattell

Garrison-on-Hudson, N. Y.

SCIENTIFIC BOOKS

The Biota of the San Bernardino Mountains. By Joseph Grinnell. University of California, Publications in Zoology, Vol. V., No. 1. Pp. 170, plates 24. December 31, 1908.

As a contribution to the zoology and botany of southern California, Mr. Grinnell has given us a paper based on three summers' field work in the San Bernardino Mountains. Its principal sections are: "Life Zones of the Region," with lists of characteristic species of plants of each zone; "Descriptions of Localities," with special reference to their zonal positions; "General Considerations relating to Bird Population; a List of the Important Plants," largely trees and shrubs, with notes on their distribution; "A List of 139 Species of Birds," with detailed notes on distribution, breeding, food and other habits; "A List of 35 Species of Mammals," with notes on distribution, abundance and habits; and "A List of 20 Reptiles," lizards, horned toads and snakes, with notes on range and habits.

It is a great satisfaction to find a fellow worker in the field of geographic distribution who, instead of discovering at once new laws and naming new distribution areas, accepts and follows with conscientious care the general principles of distribution governing the transcontinental life zones and their subdivisions, as worked out by the U. S. Biological Survey. Even the color scheme of the biological survey zone map is followed, with one exception, which is possibly accidental or the fault of the lithographer. This exception consists in using red, which is usually applied to Tropical zone, for Lower Sonoran, which should have been orange. The colors of the higher zones, yellow for Upper Sonoran, blue for Transition, and green for Boreal, are standards so long in use as to have become familiar to many. Uniformity in such details is helpful to all who use zone maps.

In reviewing a work of such general excellence, and with so few faults, it seems ungracious to attack the first word in the title, but to many of us, either of the long familiar expressions *fauna and flora*, or *plants and animals*, or for brevity just *life*, would have sounded as well and meant as much as *biota*. However, as this term has been used before, the author escapes the graver criticism of introducing an unnecessary Greek substitute for a good English expression.

The use of the name tamarack, or tamarack pine, for the lodge pole or Murray pine (*Pinus murrayana*), while often used locally where there are no tamaracks, grates on the nerves of those brought up among the real tamaracks (*Larix*), as well as those to whom the name lodge-pole pine recalls camps on the borders of beautiful mountain meadows or the sharp cones of slender tepee poles in the camps of Cheyenne, Arrapahoe, Blackfeet, Crow and Sioux. It may not be possible to correct local misuse of names, but why extend it?

An evident error in the zone map consists in extending Transition zone to the upper limit of *Pinus jeffreyi* instead of confining it to the limits of *Pinus ponderosa*, *Pinus lambertiana*, *Libocedrus decurrens*, *Quercus californica* and the accompanying set of plants and animals. As a result the zone is extended in places at least five hundred feet too high, and the Canadian zone above is correspondingly narrowed. This has apparently resulted from a failure to clearly discriminate between *Pinus ponderosa* and *jeffreyi* and therefore to crediting them with the same range (p. 81). *Pinus jeffreyi* in the San Bernardino, San Jacinto and Sierra Nevada Mountains ranges generally 500 to 1,000 feet higher than *ponderosa*, and by just this much overlaps the lower edge of Canadian

zone.[1] While leading to some confusion in the resulting effort to separate Transition zone into upper and lower divisions, this error is largely compensated by the fact that the vertical range of each species is given and the zones can be checked up thereby. When the zone-marking species are accurately mapped over wider areas, such local defects are easily eliminated.

Approximately ninety pages are devoted to notes on the 139 species of birds, and it is only fair to say that few lists of equal length have contained so much important data on distribution, abundance, migration and habits. A chapter on Bird Population and its Modifying Influences throws much light on local migrations up and down the mountains in pursuit of food, while the bird census and the varying abundance of birds in relation to insect food show the vital importance of birds in an agricultural region. The great number of nesting records, each with date, exact locality, altitude and zonal surroundings, gives for the first time sufficient data for mapping the breeding zones of many of the species in these mountains and furnishes a mine of material for the student of distribution. The nesting habits, food habits, songs, call notes, rare eggs and rare or little known plumages are described and much information that is actually new is put on record.

The notes on 35 species of mammals cover twenty-six pages and are practically all first-hand records of observations on distribution, abundance, food and habits. Many of the species that show local variation or interesting peculiarities are described in detail and in some cases tables of measurements are given. All of these notes are of permanent value and contribute toward a fuller knowledge of our native mammals.

Eleven pages of notes on lizards and snakes are of importance in defense of these interesting, useful and much maligned animals.

Besides the colored zone map and transverse section of the mountain zones there are twenty-two full-page plates from photographs of mountain scenery, trees, shrubs, birds' nests and snakes.

The value of such detailed, accurate and reliable local surveys is appreciated nowhere more than in the U. S. Biological Survey, which is working along the same lines over wider fields.

Vernon Bailey

[1] The same error of extending transition zone to the upper limit of *Pinus jeffreyi* was made by Dr. H. M. Hall in his otherwise accurate and excellent botanical survey of the San Jacinto Mountains, and in this case also it led to an effort to separate the zone into upper and lower divisions. (See University of California Publications in Botany, Vol. I., pp. 1–140, 1902.)

The Microscope; an Introduction to Microscopic Methods and Histology. By Simon Henry Gage, Professor of Histology and Embryology, Emeritus in Cornell University. Tenth edition. Pp. 359, 258 figures.

The tenth edition of this well-known book on the microscope retains all the meritorious features which have contributed to the success of the former editions. It has been the author's constant desire to have his book represent the "present state of knowledge of the microscope and the technique of its employment." All who have had acquaintance with the former editions (and who among microscopists has not?) know how successful he has been in accomplishing this end. In the present edition, besides incorporating discussions of new or improved features of the microscope and its accessories, additions have been made to the sections dealing with the manipulation of materials.

The same general order of presentation has been followed as in former editions. Of the ten chapters which constitute the work, chapters I.–VII., deal with the microscope and its appliances. Chapter VIII. is given up to various methods of photography (including photographing with a microscope, photographing opaque objects and the surface of metals and alloys, enlargements, etc.) and is rich in practical directions and advice, serviceable to the experienced, as well as to the inexperienced, worker. Chapter IX. is devoted to the preparation of reagents, the making of microscopic mounts, together with notes and comments on materials, methods of storing, and

the like, and is interspersed with numerous useful hints and cautions. In the 48 pages of chapter X., the author gives a concise statement of the fixation, sectioning, staining and mounting of tissues, together with brief discussions of microtomes and section knives, drawings for book illustrations, and the preparation of models. The practicability of the method for making models of blotting paper will appeal to all biological workers.

The book is remarkably free from typographical errors. Only two or three insignificant ones have been noted by the reviewer, as: the omission of the prime marks of *A'B'*, Fig. 15, page 6; *ecently* for *recently*, page 260; and *speimen* for *specimen*, page 282.

An extended review of the book would be superfluous as its merits are already sufficiently known to the readers of SCIENCE. Its past success is adequate commentary on the author's judgment as to what is needful in a book devoted to the principles involved in making microscopic observations.

MICHAEL F. GUYER

SCIENTIFIC JOURNALS AND ARTICLES

THE April number (volume 10, number 2) of the *Transactions of the American Mathematical Society* contains the following papers:

L. E. Dickson: "General theory of modular invariants."

I. Schur: "Beiträge zur Theorie der Gruppen linearer homogener Substitutionen."

E. J. Wilczynski: "Projective differential geometry of curved surfaces (fourth memoir)."

Edward Kasner: "Natural families of trajectories: conservative fields of force."

G. W. Hartwell: "Plane fields of force whose trajectories are invariant under a projective group."

W. A. Manning: "On the order of primitive groups."

G. D. Birkhoff: "Existence and oscillation theorem for a certain boundary value problem."

Maxime Bôcher: "On the regions of convergence of power series which represent two-dimensional harmonic functions."

THE April number (volume 15, number 7) of the *Bulletin of the American Mathematical Society* contains: Report of the February meeting of the society, by F. N. Cole; "Bézout's Theory of Resultants and its Influence on Geometry" (presidential address), by H. S. White; "On the Representation of Numbers by Modular Forms," by L. E. Dickson; "Note on Lüroth's Type of Plane Quartic Curves," by H. S. White and K. G. Miller; "Cantor's History of Mathematics," by D. E. Smith; "Shorter Notices": Slaught and Lennes' High School Algebra, by E. B. Lytle; Schoenflies' Einführung in die Hauptgesetze der zeichnerischen Darstellungsmethoden, by Virgil Snyder; Laurent's Géométrie Analytique Générale, by E. B. Cowley; Petit-Bois' Tafeln unbestimmter Integrale, by E. L. Dodd; Annuaire du Bureau des Longitudes, by E. W. Brown; "Notes"; "New Publications."

THE May number of the *Bulletin* contains: Report of the February meeting of the San Francisco Section, by W. A. Manning; "The Construction of a Space Field of Extremals," by E. G. Bill; "The Second Variation of a Definite Integral," by A. L. Underhill; "A Simpler Proof of Lie's Theorem for Ordinary Differential Equations," by L. D. Ames; "Heath's Euclid," by D. E. Smith; "Shorter Notices": Czuber's Differential- und Integralrechnung, by L. W. Dowling; Fabry's Traité de Mathématiques Générales, by C. L. E. Moore; Schubert's Auslese aus meiner Unterrichts- und Vorlesungspraxis and Loria's Passato ed Presente delle Teorie Geometriche, by Edward Kasner; Müller's Führer durch die mathematische Literatur, by G. A. Miller; Voss' Ueber das Wesen der Mathematik, by Florian Cajori; "Notes"; "New Publications."

BOTANICAL NOTES

THE BOTANY OF THE FAERÖES

EIGHT years ago under the general direction of Professor Dr. Eugene Warming the first volume of a comprehensive work on the vegetation of the Faeröes Islands was published simultaneously in Copenhagen (Det Nordiske Forlag) and London (John Wheldon & Co.). It contained 340 pages of text, ten plates and

fifty illustrations in the text. There is first a short historical chapter by Warwing on the earlier botanical investigations of the islands, followed by a chapter of about thirty pages by C. H. Ostenfeld on the geography, geology, climate, etc., in which we learn that there are about twenty islands, of all sizes, from mere islets to the larger islands thirty or more kilometers long and ten to twelve in width. They lie about 7° west of the meridian of Greenwich, and in latitude 62° north of the equator, and are nearly midway between Scotland and Iceland. In general they are mountainous, the elevations reaching to between eight and nine hundred meters. The air is moist and cool, and there is much rainfall (159.3 centimeters—nearly 64 inches).

Following these general chapters are those devoted to Phanerogamae (261 species) and Pteridophyta (24 species), by C. H. Ostenfeld; Bryophyta (338 species), by C. Jensen; Freshwater Algae (323 species), by E. Borgesen; Freshwater Diatoms (248 species), by E. Ostrup; Fungi (168 species), by E. Rostrup, and Lichens (194 species), by J. S. D. Branth.

The second volume, which appeared in 1903, includes papers on marine Algae (216 species), by F. Borgesen; Marine Diatoms (182 species), by E. Ostrup; Phytoplankton from the Sea (93 species), by C. N. Ostenfeld; Phytoplankton from the Lakes (17 species), by F. Borgesen and C. H. Ostenfeld; the Hieracia of the Faeröes (21 species), by H. Dahlstedt, and concludes with a History of the Flora of the Faeröes, by Professor Warming in his peculiarly lucid and interesting style. In summing up his conclusions he says he is fully convinced "that the whole flora—at least all the more highly organized land plants—have immigrated after the glacial period, across the sea, and from the nearest countries, lying east, especially Great Britain."

The third volume, which closes the series, contains more general papers, the first by F. Borgesen being a most interesting ecological study of the marine algae, while those that follow include "additions and corrections" to previous lists of plants, popular plant names, land vegetation, gardening and tree planting, agriculture, etc. A ten-page paper by Professor Warming—"Field-notes on the Biology of Some of the Flowers of the Faeröes"—is full of suggestive observations. In an appendix of twenty-eight pages F. Borgesen and H. Jonsson present a paper on the Distributions of the Marine Algae of the Arctic Sea and of the Northernmost Part of the Atlantic for the purpose of comparing the Faeröese Algae with that of other portions of the neighboring seas.

Throughout the work the reproductions of photographs, especially of marine algae, are most excellent and some are really quite remarkable.

THE GRASSES OF CUBA

In a recent "Contribution" from the United States National Herbarium (Vol. XII., part 6) Professor A. S. Hitchcock publishes a "Catalogue of the Grasses of Cuba" which is "based primarily upon the collections at the Estación Central Agronómica de Cuba." Here are deposited C. F. Baker's collections, and the Sauvalle Herbarium. In addition to these Professor Hitchcock has had for study many Cuban collections in the National Herbarium, the collections by Charles Wright (in the Gray Herbarium), and those in the herbarium of the New York Botanical Garden. As a result of his careful studies he is able to enumerate more than two hundred species (228), while Grisebach included 154 and Sauvalle 170.

In the catalogue, in which the only descriptions are to be found in the analytical keys, ten tribes are represented and these include sixty-six genera. The northern botanist misses the *Aveneae*, *Hordeae* and *Phalarideae*, which appear to have no Cuban representatives. More than three fourths of the species are found in the genera of the series Panicaceae, and considerably more than one half (135) are in the tribe Paniceae. The largest genus (*Panicum*) contains more than a fifth of all the species. Of Bambuseae there are seven species, all of the genus *Arthrostylidium*.

As evidence of the commendable conservatism of the author may be cited the fact that he has found it necessary to found but one

new genus (*Reimarochloa*), nine new species, and to change the names (new combinations) in but nineteen cases.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

SECONDARY CHROMOSOME-COUPLINGS AND THE SEXUAL RELATIONS IN ABRAXAS

IN Professor Castle's interesting communication on sex-heredity, published in the issue of SCIENCE for March 5, a view is advanced that is akin to the "provisional formulation" that I recently offered,[1] but seems to me a decided improvement upon it. In the course of his discussion Professor Castle points out that the "XX and X" formula, which holds true for so many insects, apparently can not be applied to the conditions in *Abraxas*, as indicated by the experimental results of Doncaster and Raynor. These results only seem explicable under the view that the relation with which we have become familiar in other insects is here reversed, the female being heterozygous and the male homozygous in respect to sex (Bateson, Doncaster); and with this conclusion I concur. Definite cytological evidence has now been produced that the same is true of some other animals. The work of Baltzer, done in Boveri's laboratory[2] shows that in the sea-urchin all the sperm-nuclei are alike, while the egg-nuclei are of two classes, approximately equal in number. All of the gamete-nuclei contain 18 chromosomes. In all of the sperm-nuclei and in one class of egg 17 of these are rod-shaped in the metaphase and anaphases of cleavage, and have a terminal attachment to the spindle, while one is a long chromosome that has a subterminal attachment and therefore is hook-shaped. In the other class of egg one of the rods is replaced by a second somewhat shorter hook-shaped chromosome. The latter, therefore, forms a distinctive differential between the sexes; and cytologically considered the female is heterozygous, the male homozygous. A cytological parallel to the condition inferred from the experimental data in the case of *Abraxas* is thus demonstrated. Furthermore, if the differential chromosome in the sea-urchin is of the same general nature as the X-element of the insects, a confirmation is given of Castle's assumption that in one class of cases (*e. g.*, Hemiptera) XX means the female condition and X the male, while in another class of cases the presence of X means the female, its absence the male.

From the point of view thus given the importance of a cytological study of *Abraxas* is manifest. Thanks to the courtesy of Mr. Doncaster, I have for some time had this material under investigation; but unfortunately it presents great practical difficulties. So much may, however, be said, that while the spermatogonal divisions present a normal appearance, the spermatocyte divisions, in both the hybrid and the pure forms, show remarkably complicated and puzzling phenomena that are unlike anything hitherto described in other insects. A detailed analysis of the distribution of the chromosomes in maturation will, I fear, prove impracticable, and as far as this particular case is concerned we are for the present reduced to mere speculative guess-work. I think, however, that we should not hesitate to guess if indications for direct observation can thus be found.

Professor Castle's assumption is that the "repulsion" between the *grossulariata* factor ("G") and the female-producing factor ("X"), postulated by Bateson, "is doubtless due to the fact that the *grossulariata* character acts as the synaptic mate to the X-element." This is, perhaps, admissible; but from the standpoint of the chromosome-hypothesis it involves the following difficulty. In the heterozygous female (GLX in Castle's formula) G is assumed to couple in synapsis, not with its own homologue or allelomorph, L (as it must do in the male GL or GG), but with a different element, X. The L factor is thus left with no synaptic mate; and this result, when followed out, is found to involve still further difficulties. Even though L be regarded as merely the absence of G, this probably does not mean the absence of an entire

[1] SCIENCE, January 8, 1909.

[2] Reported by Baltzer in *Verh. d. deutsch. Zool. Ges.*, 1908, and more recently by Boveri in *Sitzungsber. d. phys.-med. Ges., Würzburg*, 1909.

chromosome, but rather the absence from the G-chromosome of a particular pigment-producing factor. I would therefore regard it as a more plausible guess that a Y-element is present in both sexes, and that both have the same number of chromosomes, the female zygote formula being XY and the male YY, as the facts in the sea-urchin suggest. The female heterozygote thus becomes GLXY, the male GLYY, and the homozygous male GGYY or LLYY. All the facts are then consistently accounted for by the single assumption that G, while acting as the synaptic mate of L, always undergoes also a secondary coupling with Y.

Did such secondary coupling not take place the female GLXY would give rise to the bivalents G/L and Y/X, producing the four classes of gametes GX, GY, LX and LY. If, however, in addition to the primary synaptic coupling of X and Y, G also couples secondarily with Y, the result should be a quadrivalent element, which might have either the tetrad grouping

GY
LX

or the linear grouping

G
Y
—
X
L

giving in either case the two classes of gametes GY and LX. In the males, GLYY or GGYY, the gametes will of course be GY, LY or GY, GY respectively. This gives a series of formulas identical with those of Bateson and Doncaster, as recast by Castle, if Y be everywhere inserted in its proper place, as follows:

Parents	Constitution	Gametes	Offspring
(1) *Lact.* ♀	LLXY	LX, LY	GLXY = *gross.* ♀
Gross. ♂	GGYY	GY, GY	GLYY = *gross.* ♂
(2) *Het.* ♀	GLXY	GY, LX	GGYY = *gross.* ♂
Het. ♂	GLYY	GY, LY	GLXY = *gross.* ♀
(3) *Lact.* ♀	LLXY	LX, LY	GLXY = *gross.* ♀
Het. ♂	GLYY	GY, LY	GLYY = *gross.* ♂
			LLXY = *lact.* ♀
			LLYY = *lact.* ♂
(4) *Het.* ♀	GLXY	GY, LX	GLYY = *gross.* ♂
Lact. ♂	LLYY	LY, LY	LLXY = *lact.* ♀

This adds nothing in principle to Castle's suggestions, but seems more in accordance with cytological expectation.

Such a mode of coupling may seem very improbable; but I wish to point out that there are at least some approximate analogies to it in cytological facts known in other animals. Several different types of multiple elements, formed by definite chromosome-couplings, are now known. An example is given by *Metapodius* (which I have recently described in detail). In individuals having "supernumerary" chromosomes these regularly couple with the idiochromosome-bivalent in the second division to form triad, tetrad, pentad and even hexad complexes; and the components are often arranged in linear series. I have recently obtained an individual of *M. femoratus* which differs from all other individuals of the species thus far examined in possessing a single odd or accessory chromosome, while the missing small idiochromosome is replaced by a third "*m*-chromosome." The latter does not, as might have been expected, play the part of a synaptic mate to the odd chromosome, but shows throughout the spermatogenesis the characteristic behavior of its own kind. In the first division it is always coupled with the two other *m*-chromosomes to form a triad element, the three components almost always forming a linear series. Again, in *Thyanta* there are three sex-chromosomes (the Y-element and two components of the X-element) which divide separately in the first division but are always coupled in the second to form a linear triad series. In the reduvioids, as Payne has recently shown, the sex-chromosomes form in the second division dyad, triad or tetrad groups; in *Gelastocoris* they form a pentad complex; and in each case the components show a definite arrangement and mode of distribution.

A closer approximation to the secondary coupling suggested in *Abraxas* is given by the observation of Sinéty on *Leptynia* (one of the Phasmidæ), and especially by the discoveries of McClung in *Hesperotettix* and some other Acrididæ, that the X-element (accessory chromosome) is in these cases regularly coupled in the maturation-divisions with one of the

bivalents. I have found a somewhat similar condition in the coreid *Pachylis*, though the coupling is here less constant. The most significant fact, emphasized by McClung, is that in *Hesperotettix* the odd chromosome always couples with a particular bivalent that can be distinguished from the others by its size. Such a phenomenon is evidently to a certain extent of the same type as the secondary coupling surmised above as the possible explanation of the facts in *Abraxas;* and it would be most interesting to attempt crossing experiments with these grasshoppers from the point of view that is thus suggested.

Professor Castle's tempting suggestion that the Y-element in the ordinary forms of insects may be the vehicle for the transmission of secondary male characters that are not represented in the female interests me because I had considered an identical view but withheld it for two reasons. One was that in forms like *Pachylis, Archimerus*, etc., where the Y-element is wanting, the male secondary characters are as well developed and characteristic as in forms where the Y-element is present. The other is given by the facts in *Metapodius* (since published in the fifth of my "Studies on Chromosomes"). In this case the evidence is nearly if not quite conclusive that the "supernumerary" chromosomes are duplicates of the Y-element; and they are found indifferently in either sex. The closest scrutiny of the original specimens (now in my cabinet) fails to show any trace of the male secondary characters in those females that possess supernumeraries. Since these characters are very conspicuous in *Metapodius* a decisive negative seems to be given to Castle's suggestion, as far at least as three species of this genus are concerned. The Y-element still remains a puzzle; and until it has been satisfactorily accounted for our cytological view of the problem will remain defective.

Edmund B. Wilson

THE NATIONAL ACADEMY OF SCIENCES

The National Academy of Sciences held its annual meeting at Washington on April 20, 21 and 22. The members in attendance were:

Henry L. Abbot, Alexander Agassiz, J. A. Allen, George F. Becker, John S. Billings, Franz Boas, William H. Brewer, George J. Brush, J. McK. Cattell, Charles F. Chandler, Russell H. Chittenden, W. B. Clark, George C. Comstock, E. G. Conklin, James M. Crafts, Whitman Cross, William H. Dall, W. M. Davis, W. L. Elkin, S. F. Emmons, W. G. Farlow, Edwin B. Frost, Theo. Gill, Arnold Hague, William F. Hillebrand, William H. Holmes, Joseph P. Iddings, C. Hart Merriam, S. Weir Mitchell, Edward W. Morley, Edward S. Morse, Edward L. Nichols, H. F. Osborn, Michael I. Pupin, Ira Remsen, W. B. Scott, Charles D. Walcott, Arthur G. Webster, William H. Welch, Charles A. White, Edmund B. Wilson, Robert S. Woodward.

The program of scientific papers was as follows:

"The Nature and Possible Origin of the Milky Way," G. C. Comstock.

"Determinations of Stellar Parallax from Photographs made by Arthur R. Hincks and the writer," H. N. Russel (introduced by G. C. Comstock).

"Strange Ceremonial Costumes of California Indians" (with lantern slides), C. Hart Merriam.

"Archeological Problems of the Titicacan Plateau" (with lantern slides), W. H. Holmes.

"Discovery of a Complete Skeleton of *Tyrranosaurus* in the Upper Cretaceous" (with lantern slides), H. F. Osborn.

"An Iguanodont Dinosaur (*Trachodon*) with the Epidermis Preserved" (with lantern slides), H. F. Osborn.

"Stratigraphic Relations and Paleontology of the Lower Member of the Fort Union Formation," F. H. Knowlton (introduced by Whitman Cross).

"The Deep-sea Bottom of the Eastern Tropical Pacific, from Observations on the *Albatross* Expedition," Sir John Murray (communicated by A. Agassiz).

"The Medusæ of the Eastern Tropical Pacific, from Observations on the *Albatross* Expedition," H. B. Bigelow (communicated by A. Agassiz).

"Mythology of the Mewan Indians of California," C. Hart Merriam.

"The Radiation from Gases heated by Sudden Compression," E. F. Nichols and G. P. Pegram.

"Biographical Memoir of Elliott Coues," J. A. Allen.

"Biographical Memoir of Ogden N. Rood," E. L. Nichols.

"The Electrolytic Separation of the Chlorides of Barium and Radium," Edgar F. Smith.

"The Orders of Teleostomous Fishes (Pisces)," Theo. Gill.

"Biographical Memoir of Chas. A. Schott," Cleveland Abbe.

"The Distribution of the Recent Crinoids," Austin H. Clark (introduced by Theo. Gill).

"On the Distribution of Energy in the Spectrum of the Light from Fluorescent Substances," E. L. Nichols and Ernest Merritt.

"A Geographical Excursion in Northern Italy," W. M. Davis.

THE AMERICAN SOCIETY OF NATURALISTS

THE annual meeting of the American Society of Naturalists was held in the auditorium of the Physiological Building, Johns Hopkins Medical School, Baltimore, Md., December 31, 1908. Fifty-five members were present.

On vote of the society the address of the retiring president, Professor D. P. Penhallow, in his absence, was read by the chairman, Professor T. H. Morgan. It is printed herewith.

A discussion of the functions and relations of the society followed, participated in by delegates from some of the affiliated societies and by Professors Minot, Davenport, Baldwin and Cattell. This resulted in an emphatic vote in favor of preserving the integrity of the society and of establishing a more effective cooperation between its sections. Professor C. B. Davenport offered a motion that the constitution be amended so that the executive committee of the Naturalists be composed of the secretaries of Sections F, G and K of the American Association and of the secretaries of the technical biological societies affiliated with the Naturalists, the same to form a program committee for the arrangement of papers, times and places of meeting, etc. This motion was referred to the executive committee with power to act.

Professor T. H. Morgan, on behalf of the executive committee, moved first that the study of evolution be the general policy of the society for the ensuing year; second, that the program consist of original contributions on the subject of evolution and of reports, demonstrations, etc., of important recent work in this field. The society voted to adopt this program for the current year. Members from the affiliated societies are accordingly requested to reserve contributions bearing on this topic for presentation before the Naturalists at the next annual meeting.

The place and time of the next meeting was referred to the executive committee.

Eleven new members were elected; they are: D. S. Johnson, Johns Hopkins University; R. C. Osburn, Barnard College; G. G. Scott, College of City of New York; A. H. Clark, National Museum; L. L. Woodruff, Yale University; N. E. Kellicott, Woman's College of Baltimore, Md.; R. P. Cowles, Johns Hopkins University; J. F. McClendon, University of Missouri; F. B. Sumner, Woods Hole; A. A. Budington, Oberlin College; R. Retzer, Johns Hopkins Medical School.

At an adjourned meeting in the evening the following officers were elected for this year:

President—Professor T. H. Morgan, of Columbia University.

Vice-president and Chairman of the Eastern Section—Professor W. H. Howell, Johns Hopkins University.

Additional Members of the Council—Dr. D. T. MacDougall and Professor Charles H. Judd.

Treasurer—Dr. Herman von Schrenck.

Secretary—Dr. H. McE. Knower.

Professor R. A. Harper, University of Wisconsin, is vice-president and chairman of the Central Branch of the society, and Professor J. G. Lee, University of Minnesota, is secretary of the Central Branch.

H. McE. KNOWER,
Secretary

REPORT OF THE BALTIMORE MEETING OF THE AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES

THE council of the federation met in Baltimore, Md., on Monday, December 28, at 3 P.M. Of the thirty-three members of the council, nineteen were present either in person or by proxies. The report of the executive committee, presented by Mr. J. T. Rorer, outlined the work of the year in connection with organization, the appointment of a special committee on the bibliography of science teaching, the issue of the November *Bulletin*, and preparations for the council meeting in Baltimore. It pointed out some of the specific questions which might naturally engage the attention of the officers of the federation during the coming year; emphasizing, however, the dependence of successful work on increased financial resources.

The treasurer reported a balance of $20.20 from last year, as shown in the printed statement in the *Bulletin*. The printing and mailing of the *Bulletin* had cost $53.00, leaving $32.80 chargeable to this year's account. Dues from the federated associations for this year had not yet been collected. An auditing committee, consisting of Messrs. L. S. Hulbert and C. H. Smith, was ap-

pointed, and reported later that the accounts were correct.

Interesting reports in regard to organization and methods of work were presented from the following local societies: The Association of Mathematical Teachers in New England, presented by Mr. W. T. Campbell; The Association of Teachers of Mathematics of the Middle States and Maryland, presented by Mr. Eugene R. Smith; The Physics Club of New York, by Mr. F. B. Spaulding; The Association of Biology Teachers of New York, by Mr. G. W. Hunter; The Association of Physics Teachers of Washington, D. C., by Mr. W. A. Hedrick; The New England Association of Chemistry Teachers, by Mr. H. P. Talbot; The Central Association of Science and Mathematics Teachers, by Mr. C. H. Smith; The Colorado Mathematical Society, by Mr. G. B. Halsted; The Southern California Science Association, by Miss T. A. Brookman. All the reports showed active and constructive work under way.

By unanimous consent the following article was added to the articles of federation as adopted at the Chicago meeting:

13. These articles may be amended at any annual meeting of the council by a two thirds vote of the members present provided notice of the proposed amendment has been sent to all members of the council and to the president and secretary of each federated society at least thirty days prior to the meeting.

The following resolutions were unanimously passed:

Resolved, That it is the sense of the American Federation of Teachers of the Mathematical and the Natural Sciences that larger appropriations should be made by Congress for the support of the United States Bureau of Education so as to enable it greatly to increase the scope and importance of its work and to render immediate and effective aid in the promotion of education in the mathematical and the natural sciences; and

Resolved, That the executive committee of the federation be authorized to take such action as may seem to it desirable to further such action by Congress.

Three committees of the federation were authorized as follows: One on a syllabus of propositions in geometry; one on publication and publicity, to report next year on the present needs and facilities for publishing material of interest to the federation, and to make recommendations as to ways and means of improving these facilities; one to investigate the present conditions of college entrance, to define the attitude of the federation towards college entrance problems, and to recommend action that may tend to unify and simplify college entrance requirements.

The following were elected officers for the coming year:

President—H. W. Tyler, Massachusetts Institute of Technology.

Secretary-treasurer—C. R. Mann, University of Chicago.

Other Members of the Executive Committee—G. W. Hunter, DeWitt Clinton High School, New York; J. T. Rorer, Central High School, Philadelphia; C. H. Smith, Hyde Park High School, Chicago.

Professor R. E. Dodge presented a report of progress from the committee on bibliography, showing that the sections on mathematics, physics, biology and geography were nearly completed.

A letter from Professor D. E. Smith, representing the International Commission on the Teaching of Mathematics, was presented, expressing the hope that the federation would cooperate in its undertaking in due time.

On Tuesday morning, December 30, the federation held a joint session with Section L, Education, of the American Association for the Advancement of Science. The topic, "The Problems of Science Teaching," was discussed by President Ira Remsen and Messrs. G. F. Stradling (Philadelphia), Wm. T. Campbell (Boston), John M. Coulter (Chicago), N. M. Fennemann (Cincinnati) and Lyman C. Newell (Boston), as follows:

President Remsen said:

"A battle that has long been waging has been won— the battle for the recognition of science in the courses of study in schools and colleges. I remember well my first experience as a teacher of chemistry. I had accepted a position in one of the small New England colleges without having examined the equipment. When I arrived in the fall ready to begin work, I found that the institution did not possess a laboratory. I at once applied to the president for one, and he replied: 'What for? I have taught chemistry, and I thought successfully, without a laboratory; and if I could do it, I think you can. This is not a technical school; what the students want is the broad general principles of chemistry.' So I tried to teach without a laboratory. I was wholly unsuccessful; the students learned nothing—in

fact, some of them told me so in later years. The experience was, however, very useful to me, for I learned a great deal from it.

"Now science is recognized; we have laboratories everywhere and laboratory training is regarded as indispensable. It is therefore fitting to ask: What are we doing with our facilities? What results are we obtaining? When the battle was on, men lost their heads—men must lose their heads in order to fight. We thought that if only we could get laboratories, the problems of education would be solved. Is this true?

"Pedagogical problems are hard to solve—it is very difficult to get sound conclusions. How can we tell whether the scientific training is more effective than that of the older type? This is a problem that can not be solved by sitting down and thinking about it; it can be solved only by research and experiment. I do not myself know whether scientific training as now conducted is producing the results hoped for. Yet I am convinced that scientific training, when properly conducted, may be of the greatest value as an educational force. This is quite a different thing from saying that that particular thing now known as science training is of great value. It all depends upon how it is done.

"Personally, I have been guilty of all the sins possible for a teacher of science. I have been experimenting to find out how to teach chemistry; and it is the most difficult experiment I have ever tried. My own experience in school was very instructive to me, for my own education was most unsatisfactory—in fact, I never was educated. My first experience with chemistry was gained in a course of lectures one hour a week by one of the greatest chemists of this country, Professor Wolcott Gibbs. Yet from this course I learned nothing. My second experience came when I had taken up the study of medicine. The teacher knew little chemistry, and I was asked to assist him in preparing the experiments for his lectures. He had a large practise, and left me alone to prepare experiments that I had never seen. I am almost ashamed to confess what happened that year—there were explosions and fires and bungling beyond words. I had little or no guidance.

"In my first course the instruction had been 'theoretical'; in the second I had the 'practical' galore; I therefore thought I was an experienced chemist and could go on and take an advanced course. It was a sad awakening when I found that I knew practically nothing of the subject.

"But to return to our theme: Are we doing the best that is possible with what we now have? Do the results obtained justify the equipment and time devoted to scientific study? I am not qualified to answer these questions for the schools; but speaking for the colleges, I may say that, in my opinion, the results are frequently quite unsatisfactory. The reason is that we have not yet learned how to deal with the subject. It is not hard to teach chemists chemistry, but it is very hard to teach beginners something that is worth while about chemistry in one year. What can be expected of a one-year course? Have you ever seen students who obtained an intelligent knowledge of any subject in one year? We can not expect anything of great value in that limited time. If getting knowledge of a subject is the purpose, we can not expect much of even the best teachers. But the important point is: Are we doing the best we can under the circumstances?

"There are two points in which, it seems to me, we might do better—two defects that might be remedied. One defect is that the student is not subject to enough supervision in his laboratory work. He is very much in the condition in which I found myself when turned loose in the laboratory to prepare experiments I had never seen. He is turned loose with a book, and then left alone. This is not conducive to scientific work. School authorities do not realize the need of enough teachers for the sciences. The head teacher generally expounds the subject and leaves the laboratory work to inexperienced assistants. It is too much work for the professor to have to spend four or five hours a day in the laboratory with the students. If we could get teachers with interest in their subject and in their students, it would solve the problem; but in science as in other subjects, we are not going to find these often. Unless we can find out how to produce good teachers, we shall fail to get the best results.

"The second important defect in the present teaching of chemistry in college is the absence of repetition. There are too many fleeting impressions. There is a little about a great number of things, as oxygen, hydrogen, chlorine, nitrogen, phosphorus—each being treated as something new with no reminders. In language there is much repetition; each new lesson continually connects with past work. Yet it is only by repetition that we learn. We do not learn a game by being told

how to play and then trying it once. Repetition is largely lacking in science teaching. We cover too much ground. The student gets only a veneer.

Knowledge of this sort is not of much use, and the drill given by such study is not effective. We must introduce into science teaching the drill element that comes only from repetition of the sort that is characteristic of languages and mathematics.

"Chemistry has one kind of work involving repetition of the right sort, namely, qualitative analysis. This field offers good educational possibilities, but the work is in great danger of becoming mechanical. The student is prone to go through the motions with his mind on his book, to guess at the results, to report, watching the reaction of the teacher closely, and to get credit. In order to introduce this element of repetition, quantitative work has been introduced to save the situation. Some quantitative work is desirable. It makes it possible to keep a student at one experiment till he has obtained good results. Such work is monotonous, though it has the advantage of not requiring the student to cover too much ground.

"The remedy for these two important defects is, unfortunately, unattainable at present. We must get good teachers. Much is being done in the way of training teachers, and much that is good is coming from this work. Yet we must not forget that good teachers are not easily made. It is harder to train a teacher to conduct laboratory work efficiently than to train one to teach mathematics or a language. In science the laboratory presents a new problem, and serious errors have occurred and are occurring. Yet, in spite of this, great progress is being made, and there is little doubt that in the end scientific training will fully justify itself in the schools and colleges.

"In closing let me again specifically state that I do not consider myself competent to speak of science training in the secondary schools; all that I have been saying applies, as far as my own definite knowledge goes, only to the colleges."

Dr. G. F. Stradling showed that there has been no notable change within the past decade in the relation of doctorates in physics to the whole number conferred in the United States, nor has any notable change in the proportion of students offering physics upon entrance to college taken place. There has, however, been a very marked decrease in the percentage of all high school students taking physics.

From 1890 to 1906 the high school population became two and three fourths times as great, while the number of students of physics merely doubled. Had the ratio of 1890 held unchanged, 49,000 more students would have been studying physics in the high schools in 1906. In 1890 about 21.3 per cent. of all high school students studied physics, in 1906 only 15.5 per cent. For chemistry the numbers are 9.6 and 6.8. Every year since 1894, without exception, has shown a smaller percentage of students in physics.

From 1890 to 1906 the percentage of Latin students grew from 33.6 to 50 per cent.; of German students, from 11.5 to 21 per cent.; of algebra students, from 43 to 57.6 per cent.

Chemistry, astronomy, physiology, geology and physical geography all are losing ground in the high school. The sum of the percentages of students in these branches and in physics in the period named fell from 93 to 67 per cent., while the sum for Latin, Greek, French and German rose from 71 to 84 per cent.

Causes suggested for these changes were: (1) introduction of a wider system of electives; (2) lack of well-prepared teachers, and (3) change in the method of teaching.

A commission of the caliber of the committee of ten ought to investigate thoroughly the conditions of science teaching in the United States. An increased appropriation from Congress to the Bureau of Education would help to bring about such an investigation.

Mr. William T. Campbell, of the Boston Latin School, claimed that more attention is needed to the care of students of average mathematical ability. Under the elective system these drift into other paths. Something has been done to make the subject more attractive to them; but more remains to do. It is doubtful whether our present course, even if improved, will meet the situation. Considerable change in the direction of practical work and of closer connection with other sciences is needed.

Professor Coulter pointed out that, while the problems of the teaching of botany were constantly changing, those at present most urgent seem to be: (1) to get the prepared teacher who has a general knowledge of the fundamentals of botany, clear conceptions of the purpose of botany in the secondary schools as distinguished from higher institutions, and ability to attack the subject in a variety of ways; (2) the place of economic

botany or agriculture in the botanical instruction; (3) the biological grouping of subjects; (4) the holding of the interest of the students, *i. e.*, the finding of the effective point of contact for botany with students who are looking for practical values. No formulation of the value of botany can be made until these problems have been settled. The time is now ripe for a well-organized investigation, to be followed by a statement of well-established conclusions.

A full report of the meeting will be issued in pamplet form early in May. This will be sent to the members of the federation. Any one may obtain copies by applying to the secretary.

C. R. MANN,
Secretary

THE UNIVERSITY OF CHICAGO

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION F (ZOOLOGY)

THE vice-presidential address at the Baltimore meeting was delivered by Professor E. B. Wilson. It was published in SCIENCE, January 8, 1909.

The secretary has received abstracts of papers read as follows:

Brood-protection and Sexual Dimorphism among Echinoderms: HUBERT LYMAN CLARK, Harvard University.

The large number of echinoderms now known (about fifty) which protect or care for their young in some way show great diversity in the method used. The eggs may develop outside the body of the parent or more rarely within the body-cavity or in special reproductive cavities. If developed outside the body, the young may become attached to some part of the parent, or be sheltered among her spines or covering plates, or simply be brooded beneath her ventral surface. If developed within the parent, the young may swim about freely in the body-cavity, or more rarely undergo their development in the reproductive organs, which are thus practically uteri.

Among all these brood-protecting species, however, there seem to be only half a dozen (about twelve per cent.) which occur in tropical waters, while more than sixty per cent. are found in Antarctic or South Temperate seas.

Only four species, and these all from between 30° and 60° S. latitude, show any marked sexual dimorphism. In one, an ophiuran, the male has only five arms, the female, six to eight (Koehler). In another, a holothurian, the development of a peculiar brood-chamber in the dorsal integument distinguishes the female. The third is a spatangoid in which the lateral petals of the female are much broader and deeper than those of the male and serve as brood-pouches. The fourth is a clypeastroid, recently discovered in the Australian collections of the "Thetis," in which the abactinal area of the female is deeply depressed to form a horseshoe-shaped brood-chamber, wholly wanting in the male.

Notes on the Eggs of the Anura of Ithaca, N. Y.: ALBERT H. WRIGHT, Cornell University.

Eight species of Anura are found at Ithaca, N. Y., namely: *Rana sylvatica, Hyla pickeringii, Rana pipiens, Bufo lentiginosus americanus, Rana palustris, Hyla versicolor, Rana clamitans* and *Rana catesbiana.*

The first five species appear from hibernation and spawn under a maximum air temperature of 43–50° F.; the last three delay until the maximum reaches 70° F. or more. The first five usually breed from the last of March until the middle of June; the last three, from the last of May into August. All but two species, *Bufo l. americanus* and *Rana clamitans*, occupy four or five weeks for the spawning period. The exceptions may require two or three months. The number of eggs may vary from 800 in *Hyla pickeringii* to 20,000 in *Rana catesbiana.*

The eggs of three species, *Hyla versicolor, Rana clamitans* and *Rana catesbiana*, float more or less at the surface of the water; the eggs of the other five are submerged. The five species with submerged eggs are the first to breed. They deposit eggs with firm jelly envelopes, several eggs appearing at an emission except in *Hyla pickeringii*, where only one appears at an emission. The three with buoyant eggs breed after May 25. They deposit at the surface masses or films of eggs with loose jelly envelopes, several eggs being deposited at an emission. The best differential egg characters are: the manner of deposition, the nature of the jelly envelopes, the color of the vitellus, the diameters of the vitellus and jelly envelopes, the number of eggs and the season of deposition.

Factors Determining the Movement of Melanin Pigment Granules: OSCAR RIDDLE, University of Chicago.

Movement of these particles from one part of the cell plasma to another, and from one cell to another, is probably determined either by the solubility properties or by the electrical state of the granules. Author obtained no evidence of solubility. The granules are, however, definitely proven to be colloidal bodies bearing a negative

electrical charge—the granules unfailingly moving toward the anode when placed in an electrical field of light intensity. The author thinks this explains not only the movements of independent granules, but the movements of some chromatophores as a whole—as for example the skin chromatophores of lower vertebrates and the retinal pigment of arthropods and vertebrates. And, finally, this fact is of very considerable importance in a consideration of the physiology of color inheritance.

The Rate of Digestion in Cold-blooded Vertebrates in Relation to Temperature: OSCAR RIDDLE, University of Chicago.

By the use of Mett's tubes and a constant temperature tank, information was sought and obtained from cold-blooded vertebrates on the following points: (1) A definite measure of the rapidity of digestion, (2) comparison of this rate in fishes, amphibians and reptilia, (3) seasonal variations in digestive power, (4) a direct and definite measure of the effect of raising or lowering the temperature of the animals, on their rate of digestion, (5) the temperature coefficients of digestion in these animals.

It appears that a gradual loss of digestive capacity has occurred in the amphibia and reptilia during their evolution; and the bearing of this fact on the development of warm-bloodedness in the vertebrata seems to merit attention.

The Hyo-branchial Apparatus of Typhlotriton: WM. A. HILTON, Cornell University, Ithaca, N. Y.

The hyo-branchial skeleton of *Typhlotriton spelæus* in the adult resembles *Spelerpes* rather than members of the family Desmognathidæ in which it has been placed. The hyo-branchial skeleton of the larva resembles *Spelerpes* much more than the larva of *Desmognathus*. Like *Spelerpes* it has but three branchial arches, while *Desmognathus* has four.

Typhlotriton is a cave form, but from its eyes and other structures it seems to have much more recently come to such an environment than *Typhlomolge*. The hyo-branchial apparatus of *Typhlotriton* larva is almost the same as that of the supposed adult, but possible larval form of *Typhlomolge*.

A series of apparently related species beginning with those living in caves only to a slight degree and ending with those best adapted to a subterranean life, is as follows: (1) *Spelerpes longicaudus*, (2) *Spelerpes maculicaudus*, (3) *Typhlotriton spelæus*, (4) *Typhlomolge rathbuni*.

Some Egg-laying Habits of Amphitrite: JOHN W. SCOTT, Kansas City, Mo.

(1) The egg-laying reflex of *A. ornata* is closely associated with the time of spring tide, the height of any given period of egg-laying always occurring within three days of the time of new or full moon. In early summer the period of sexual activity tends to occur after, in late summer before, spring tide. (2) Eggs and sperm float free in the body-cavity, and are usually in various stages of development. Ripe eggs show the metaphase of the first maturation spindle, and eggs in this stage have a greater density than unripe eggs. It is entirely probable that the apparent selection of ripe and rejection of unripe eggs by the nephridia is due to the different effects produced by nephridial currents upon bodies of differing densities.

Bilateral Symmetry in the Development of the Primary Septa of a Living Coral: J. W. MAYOR, Cambridge, Mass.

The usual bilateral symmetry in the development of the first six pairs of mesenteries is shown to occur in *Agaricia fragilis*. The six primary septa are found to be arranged about a plane of bilateral symmetry which is the same as that for the soft parts, and the exosepta are found to arise in bilateral pairs. The bilateral symmetry of the primary septa is found to persist in later stages with well developed epitheca and exosepta. The arrangement of the primary septa in *Agaricia* is different from that in *Siderastræa radians* as described by Duerden, but agrees with that in *Lophophyllum proliferum* as described by the same author.

Autotomy of the Hydranth of Tubularia: MAX MORSE, College of the City of N. Y.

Hydroids commonly absorb their hydranths when placed under artificial conditions. *Tubularia* is an exception, and pinches off the hydranth entirely from the stem. Later it regenerates a new hydranth. There is no disintegration of the cells until after the hydranth has fallen off. Temperature is the active factor in inducing the process; hence *Tubularia* naturally occur fully developed at certain definite periods.

Rôle of the Nerve System in Regeneration in Earthworm and Newt: A. J. GOLDFARB, Columbia University.

The accumulated evidence points to the conclusion that early embryos and larvæ can regenerate missing organs independently of morphogenic influences exerted by or through the nerve system. Concerning the rôle of the nerve system in adults

there is a great diversity of opinion. Experiments upon the earthworm were intended to reexamine the evidence with regard to the influence of the nerve cord on the regeneration of the head. Removal of the cord from the amputated end, for a distance sufficient to prevent innervation of that end, did not inhibit the formation of a functional head.

After determining the number and origin of the nerves supplying the rear limbs and different levels of the tail in the common newt, *Diemyctelus viridescens*, the cells from which these nerves arise were totally destroyed, in both the nerve cord and the ganglia. The cord in the adjoining regions was also destroyed to prevent secondary innervation. Subsequent examination of serial sections established the fact that both the tail and the rear limbs replaced missing parts in the total absence of nerve stimuli, that where under certain special conditions regeneration did not take place, the motor and sensory functional nerves at the amputated end were unable to stimulate the organ to regenerate the lost parts.

Nuclear Components of the Sex-cells of Cockroaches: MAX MORSE, College of the City of New York.

The author presented evidence for: (1) A sex-difference in the chromosomes of the ovary and testis cells, (2) reduction by parasynapsis involving two longitudinal divisions of the chromosomes, (3) the absolute distinction between plasmosome (achromatic nucleolus) and the odd chromosome, contrary to Moore and Robinson, Foot and Strobell, Arnold and others, (4) the individuality of the chromosomes.

Featherless Fowls: R. H. CHAPMAN, U. S. Geological Survey.

The writer called attention to an abnormal condition in chickens seen by him at Delhi, N. Y., during summer and fall of 1908. Some 500 birds of the barred Plymouth Rock breed were incubator hatched between June 5 and 20. Of this number about ten per cent. failed to develop normally—a small number were deformed or became "crazy" after a short time and all (of the ten per cent.) failed in bodily growth and normal feathering. By November 10 all of the naked birds had died. The eggs had come from a farm in the vicinity and the parent birds had been inbred for four or five years.

On the Skull and the Brain of Triceratops: O. P. HAY, Washington, D. C.

This paper questions the correctness of the accepted view that the frill of *Triceratops* has as its median element the parietal bone. This median element is either a greatly developed nuchal scute or coalesced supratemporal bone. The parietal is that bone which has hitherto been called the supraoccipital. The foramen that Marsh called the pineal foramen, by others the postfrontal foramen, is properly the coalesced supratemporal foramina.

On the Intellect of Animals: ALEXANDER PETRUNKEWITCH, Short Hills, N. J.

Since man can judge of the thinking processes in animals from their actions only, the chief problem is to establish the relation between thought and actions. Conclusions from actions as to presence or absence of reasoning are often based on too little evidence and admit different interpretations. The chief difference in actions of man and those of animals is usually found in the absence of choice in animals. The conclusion which the author supported by new evidence is that reasoning has been gradually developed with the progress of evolution and is certainly to be found in its simpler forms in some higher mammals at least.

Olfactory Nerve, Nervus Terminalis and Preoptic Sympathetic System in Amia calva: CHAS. BROOKOVER, Buchtel College.

The olfactory nerve arises from an ectodermal placode in *Amia*. Nuclei migrate from the placode along the olfactory nerve toward the brain. Some of these nuclei produce sheath cells of the olfactory nerve. Others of the nuclei become enlarged, produce a ganglion two days after hatching, and when the fish is 50 mm. long number about two hundred and fifty cells. Allis homologized this ganglion and its nerve with Pinkus's nerve in *Protopterus*. There are nearly a thousand cells in each adult nasal capsule of *Amia*. They show Nissl bodies. Some are multipolar nerve cells. It is suggested from their relation to the blood vessels that these ganglion cells are vaso-motor in function. About fifty coarse fibers differing from olfactory fibers are found entering the olfactory bulbs. Other fibers extend posteriorly ventrally of the brain. A nervus terminalis is present in *Lepidosteus* and teleosts.

Nerve fibers with ganglion cells inside the cranial cavity were found entering from the profundus branch of the fifth nerve. These fibers innervate the paraphysis and blood vessels of the meninges of the forebrain. Some of the fibers extend forward as far as the nerve of Pinkus (nervus terminalis) and may form a sympathetic

connection with the latter nerve. The pineal stalk is innervated by a bundle of about thirty fibers connecting with the brain just caudad of the habenular body. Intravitam methylene blue preparations of the stalk of the epiphysis show ganglion cells with an interlacing plexus of fibers very similar to the sympathetic innervation of the walls of the intestines of vertebrates.

Effects of Brachycephaly and Dolichocephaly upon the Teeth of Man: RAYMOND C. OSBURN, Barnard College, Columbia University.

A study of various types of skulls to show the variations in the dental arch, and especially in the teeth themselves. The principles which have been stated by Professor H. F. Osborn (*Bul. Am. Mus. Nat. Hist.*, Vol. XVI., art. 7) as operating in various groups of lower mammals are here shown in man within the limits of a single species.

Some Noteworthy Additions to the Bryozoan Fauna of our Atlantic Coast: R. C. OSBURN, Columbia University.

A series of lantern slides showing various families, genera and species of Bryozoa new to our east coast fauna. A preliminary report of certain of the more striking forms collected by the author at the Tortugas, Beaufort and Woods Hole stations.

Fission and Regeneration in Sagartia luciæ: D. W. DAVIS, Sweet Briar College, Va.

The sexually derived, undivided individual in *S. luciæ* is probably a regular hexamerous form with six pairs of complete mesenteries. Of these, two pairs situated at opposite ends of the major transverse axis are directives and each directive pair is associated with a siphonoglyph. A secondary cycle, of incomplete mesenteries arranged in pairs, alternates with the pairs of the first cycle. A third cycle is usually present, and even a fourth may be represented. Longitudinal division is so common that such undivided animals are rare, and fission followed by regeneration plays an important part in the life-history. Fission occurs, almost without exception, in endocœls and, in about two thirds of the cases examined, in complete endocœls. The fission-plane shows a decided tendency to pass at right angles with the major transverse axis, producing bilaterally symmetrical pieces, but with little regard to an accurate halving of the dividing animal.

In regeneration, from eight to ten complete mesenteries are formed, the precise number depending upon the complete or incomplete character of the mesenteries at the boundaries of the old part. The new mesenteries are formed in a characteristic succession not harmonizing with an *Edwardsia* type of development but corresponding to the order described by the Hertwigs for two (possibly regenerating) specimens of *Adamsia*.

Reactions of the Dogfish to Chemical Stimuli: R. E. SHELDON, University of Chicago.

The smooth dogfish, *Mustelus canis* (Mitch.), was tested over the entire body surface, mouth, spiracle and nostrils with acid, saline, alkaline, sweet and bitter substances. The fish was found to be very sensitive over the entire surface to acids and alkalis in very dilute solution. It is less sensitive to salts and bitter substances and does not react at all to sweet solutions. The general body surface, particularly the fins, are more sensitive to alkalis and salts than is the mouth; both are equally sensitive to acids, while the mouth is the more sensitive to bitter substances. When the spinal cord is destroyed no reactions are obtained from the caudal part of the body, showing that the lateral line nerves have nothing to do with these reactions. When the cord is severed from the brain, the caudal part of the animal is more sensitive than before to chemical stimuli. There is no spinal shock after section of the cord. The nostrils are very sensitive to alkalis, acids, salts and bitter solutions. Section of the olfactory crura and different rami of the trigeminus nerve showed that this sensitiveness is due to the maxillaris nerve rather than the olfactory. Parts of the body were overstimulated for tactile response, after which they could always be stimulated chemically. When any region was overstimulated for any given chemical, as an acid, it rarely responded to tactile stimuli, although it usually responded to other chemical stimuli, as a saline or alkaline solution. When cocaine was applied to the skin, tactile response disappeared before chemical. Among the different chemical senses, bitter disappeared first. This sensitiveness to chemical stimuli is due almost exclusively to the nerves of general sensation, not at all to the olfactory nerve and very little, if any, to the gustatory nerves.

Chondrocranium of an Embryo Pig: CHAS. S. MEAD, New York City.

The study of the chondrocranium of *Sus* is of value not only in assisting us to understand the structure of the adult skull in this form, but also on account of its bearing on the general morphology of the mammalian cranium. Owing to its relatively low position in the ungulate series, we would expect many primitive characters to be retained in its cartilaginous cranium, and indeed

this is the fact, for a number of reptilian characters are present.

The notochord, near the middle of its passage through the skull, dips beneath the basal plate and is connected with the dorsal wall of the pharynx in two places. The cartilages which will later form the ear-bones are of the type common to the mammals at this stage of development. A foramen nervus abducens is present. It is in the same position as the similarly named foramen in the reptiles, but the two are not homologous, that in *Sus* being secondary. The cranial cavities in the reptiles and mammals are not strictly homologous, but the cavity in the mammals is larger morphologically than that of the reptiles and has been increased by the addition of the reptilian cavum epiptericum. Vestiges of the primitive side wall of the cranium are found in *Sus*. Taken as a whole, the chondrocranium of the pig is that of a generalized mammalian type. It shows certain specialized characters such as the narrowed anterior portion of the basal plate, the large size of the ear capsules, and the secondary foramen nervus abducens, but these are less striking than the secondary characters of *Echidna*, *Talpa*, *Lepus* or the Primates.

Placentation of an Armadillo: H. H. LANE, State University of Oklahoma.

The placentation of the Edentates has not been thoroughly studied and only a few observations have been recorded. A female nine-banded armadillo (*Tatu novemcinctum*) in captivity gave birth to four young, and an examination of the deciduate placenta revealed some novel features. There was a complete fusion of the four chorionic vesicles into one. The four amnia were united so as to divide the chorionic cavity into four longitudinal chambers, each with a single umbilical cord attached to its wall. In this specimen the placenta is intermediate in form between the zonary and the discoidal. The villi are present in a broad band surrounding the chorionic vesicle, which is barrel-shaped and has thin membranous ends devoid of villi. The villous band is made up of two disc-shaped areas of very long villi, separated by two bands of very short villi. Each of the two areas with long villi has on its amniotic surface the points of attachment of two umbilical cords. There is no indication of a decidua capsularis. This highly developed placenta would indicate that the armadillo is a specialized form, instead of a primitive type; and if this character is of systematic value, the Edentata are to be regarded as a heterogeneous group and not a natural one.

Cestodes in Flesh of Marine Fishes: EDWIN LINTON, Washington and Jefferson College.

The only common food fishes found to harbor cestodes habitually in the flesh are the butterfish (*Rhombus triacanthus*) and the harvest fish (*R. paru*). The cestode is *Otobothrium crenacolle*. The adult stage has been found in the hammerhead shark (*Sphyrna zygæna*) in New England waters, in the sharp-nosed shark (*Scoliodon terræ-novæ*) at Beaufort, and in the cub shark (*Carcharhinus platyodon*) at Tortugas.

In the encysted stage it has been found in twelve species of Woods Hole fishes, in thirteen species of Beaufort fishes and in three species of Bermuda fishes. In all these, with the exception of the butterfish and harvest fish, the parasites were confined to the body cavity where they were encysted on the viscera or in the walls of the stomach and intestine. In the summer of 1908, butterfish to the number of 715 were examined and cysts were found in all but 22. Twelve harvest fish were examined and numerous cysts were found in each. The paper discusses the exceptional position of these cysts in the butterfish and the unusually high percentage of affected fish.

Systematic Relations of the Urodela as Interpreted by a Study of the Sound-transmitting Organs: H. D. REED, Ithaca, N. Y.

This study is the result of the curiosity aroused by the apparent conflicting statements regarding the systematic position and relationships of the various groups of Urodela. Believing that the limits and position of some of the larger groups have been based upon structures which are either affected by environment or negative in their character, and, furthermore, believing that the classification of any group is sounder when based upon results gained from a comparative study of several organs or systems, it was decided to place in evidence a comparative study of the sound-transmitting organs already under investigation with another end in view.

Cryptobranchus is the most generalized. The Ambystomidæ are intermediate between *Cryptobranchus* and all other groups. The Plethodontidæ and Desmognathidæ are departures from the *Ambystoma* stem while from these the Sirenidæ and *Amphiuma* seem to be degenerated. *Diemictylus* and *Triton* are identical with regard to these ear structures and differ from all others. They are to be considered the most specialized. Between *Diemictylus* and *Triton* on the one hand and the Ambystomidæ on the other *Salamandra* stands intermediate, resembling more strongly the Ambystomidæ.

Morphology of the Sound-transmitting Apparatus in the Amphibia: B. F. KINGSBURY and H. D. REED, Cornell University.

Study of serial sections and models of representatives of eight families and seventeen genera of tailed amphibia has shown that there are two skeletal structures fitting in the fenestra vestibuli. The first of these, which we designate as the columella, is connected with the cephalic edge of the fenestra when a connection exists between the ear capsule and columella at all. It bears a more or less well developed process primarily connected with the squamosal bone in *Necturus*, *Proteus* and *Cryptobranchus*. In adult *Ambystoma*, *Amphiuma* and *Siren* there is a secondary connection of this process with the quadrate. The second element, which we designate as the operculum, has no skeletal connections but affords attachment to a muscle, the m. opercularis of Gaupp. When attachment of this element to the ear capsule occurs it is with the caudal margin of the fenestra. The cephalic end of the operculum is included within the lips of the fenestra vestibuli while in its caudal extent it protrudes. This is the type found in *Diemiotylus* and *Triton*. In the larval *Ambystoma*, at transformation, the columella becomes incorporated with the ear capsule while from the latter the operculum is cut out essentially by an extension of the fenestra vestibuli. In the adult of some forms, *e. g.*, *Diemictylus* and *Triton*, only the operculum is present while in others, *e. g.*, *Ambystoma* and *Salamandra*, both elements are represented. In still other forms such as *Plethodon* and *Gyrinophilus* both columella and operculum seem to be present and very closely associated, although the developmental stages upon which the final explanation of the morphologic relations depends have not yet been examined.

On the Effects of Centrifugal Force on the Development of the Eggs of the Frog and Sea Urchin: J. F. MCCLENDON, University of Missouri.

The unsegmented egg of *Rana pipiens* subjected to a centrifugal force $= 2{,}771 \times$ gravity for several minutes, is separated into three layers as follows: a centrifugal yolk layer containing the black pigment granules, an intermediate protoplasmic layer (containing the nuclear elements) and a centripetal fatty layer colored with yellow pigment. Egg material was centrifuged in mass and enough of each layer obtained for certain chemical analyses. Morgan found in 1902 that a certain amount of centrifuging prevented the centrifugal layer from developing. When subjected to more centrifuging no part of the egg develops. When the centrifuged egg partially develops, the centripetal and intermediate layers are more or less mixed in the early cleavage, so I have in the following tables added together the analyses of the centripetal and intermediate layers under the name of the former. Table I. gives the per cent. of water (W.) and solids (S.) in the layers. Table II. gives the per cent. of extracts (E.E. = ether extract, A.E. = alcohol extract, W.E. = water extract) and residue (R.) in the solids. Table III. gives the per cent. of phosphorus (P.) in the extracts and residue. Cp. = centripetal and Cf. = centrifugal layer.

TABLE I.

Layer	W.	S
Frog: Cp.	74	26
Cf.	48	52
Arbacia: Cp.	88	12
Cf.	79	21

TABLE II.

Layer	E.E + A.E.	W.E.	R.
Frog: Cp.	51	34	15
Cf.	30	10	60
Arbacia: Cp.	49	20	31
Cf.	38	10	52

TABLE III.

Layer	P. in E E.+A.E.	P. in W.E.	P. in R.
Frog: Cp.	0.018	1.0	0.4
Cf.	0.54	1.2	1.3
Arbacia: Cp.	2.36	17.0	3.2
Cf.	2.74	13.0	1.6

In Tables I.–III. it is observed that there are great differences between the composition of the two layers, and this is correlated with their different capacity for development.

If the egg of *Arbacia* be centrifuged it is separated first into two and later into four layers. By freezing and crushing the eggs and centrifuging in mass I obtained two layers corresponding to the two first obtained in the entire egg. Centrifugal force has little effect on the development of the egg of *Arbacia*. By inspecting the last two lines in Tables I.–III. it will be noticed that there is very little difference between these two layers in composition, and this is correlated with the fact that there is little difference in their capacity for development.

Centrifugal force causes flattening of the mitotic

[illegible] in the frog's egg in the direction of the [illegible]. This effect of the force is due apparently to compression of the alveolar framework of the [illegible] one side by the fatty layer and on the other by the yolk layer.

Regeneration and Growth in Fishes: G. G. SCOTT, College of City of New York.

The caudal fin of 117 *Fundulus heteroclitus* of sizes varying from 4.57 cm. to 9.73 cm. long was removed. Fins of the younger fishes (shorter) regenerated proportionately more than the older (longer). In fact the curve representing the proportional amount of regeneration in fishes of different ages (lengths) was regularly descending, resembling one of curve of growth established by Minot. One might conclude that regeneration paralleled growth, *i. e.*, that the power of regeneration is greater in the young. On closer examination we find that each fish (regardless of length) regenerated about 0.6 cm. The following explanation is offered: Regeneration of new fin tissue is due to proliferation outwards in a linear direction of new cells arising from the division of cells exposed by the line of amputation. A fish 5 cm. long contains same sized cells as a fish 10 cm. long and the probability is that the power of proliferation is about the same in the cells of fishes of each size—provided that the cells are at the same relative level in each case. When the amputation was made the author endeavored to have line of removal at same relative place in all specimens. Evidence as to the similar powers of regeneration residing in cells of same level independent of size (age) is shown by the fact that actual regeneration outwards in a linear direction is same in fishes of all sizes. This indicates that regeneration is a process independent of general growth processes. It comes into play under abnormal conditions.

The Early Development of Neurofibrillæ and Nerve Function: HANSFORD M. MACCURDY, Alma College, Alma, Mich.

With the purpose to find the earliest stage at which neurofibrillæ may be discovered in the developing nerve cells and the relation between their first appearance and the establishment of conduction paths as evidenced by the earliest normal movements and reactions to external stimuli, observations were made on the larvæ of *Rana* and *Amblystoma*. Neurofibrillæ are present in the earliest optic nerve fibers and in the retinal elements long before they can perform their regular function. That they are also present in early fiber tracts of the neural tube, preceding normal movements seems amply demonstrated, but further confirmation is to be sought. It appears altogether probable that the neurofibrillæ arise practically contemporaneous with the outgrowth of the nerve fiber.

Regeneration in the Brittle-star Ophiuooma pumila, with Reference to the Influence of the Nervous System: SERGIUS MORGULIS, Cambridge, Mass.

1. Is the presence of the nerve essential for the regeneration of the arms in the brittle-star *Ophiucoma pumila?* To answer this question the radial nerve was injured by a red-hot needle near the disc, and then the arm was cut off about the middle of its length. As a control experiment another arm in the same specimen was also cut off at the middle, but its radial nerve was left intact. It was found that in the course of thirty days the arms with radial nerve intact had all regenerated normally, while those with the radial nerve injured produced only a very minute stump of new tissue. If, however, the arm broke off at the place where the nerve was injured—as occasionally happened soon after the operation—no tissue was regenerated from such an exposed surface, although arms in which the radial nerve was intact, even in the same animal, did regenerate.

2. What is the relation of the rate of regeneration to the "level" at which the arms are cut off? It was found that arms cut off at the base or at the middle regenerate much faster than those cut off at the tips.

3. What is the relation of the rate of regeneration to the number of arms removed? The removal of different numbers of arms influences the rate of regeneration of the lost arms only to a small extent; the rate of regeneration when four or five arms are removed is somewhat greater than when one, two or three arms are removed; but this correlation between the degree of injury and the rate of regeneration is not of the nature of a close parallelism.

MAURICE A. BIGELOW,
Secretary

TEACHERS COLLEGE,
COLUMBIA UNIVERSITY

SOCIETIES AND ACADEMIES

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 432d regular meeting of the society was held April 6, 1909, President Hough in the chair. The following program was presented:

New Chapters in the History of the Cocoanut Palm: DR. O. F. COOK.

It has long been thought that the cocoanut palm presents a perfect example of adaptation to a littoral environment, but this idea is delusive. The tough outer rind which is popularly supposed to have been developed as a protection against sea water is really to guard the cocoanut when it falls, and give it favorable conditions for germination. Cocoanuts require a certain amount of salt in the soil, but this condition is satisfied by soils in some interior localities as well as on the seacoast. Considerable sunshine is also needed. This, however, is met better in arid regions than by a coastal habitat and the care with which the milk is protected would argue in the same direction. Far from being a wild plant the cocoanut does not appear to thrive long away from human beings and in spite of the supposed diffusion of the tree by oceanic currents no instance of the kind is known. A consideration of the varieties of cocoanut palms and the method of their occurrence points in the same direction. Against De Candolle's hypothesis of an old world origin for the cocoanut the speaker brought forward documentary evidence that this palm was spread much wider in America than De Candolle had supposed, so widely as to preclude the possibility of a recent introduction into America. On the other hand, certain Polynesian traditions were cited pointing to an eastern origin for the cocoanut trees among the inhabitants of the Pacific islands.

Mr. Safford in discussing the paper contended for an East Indian origin. He called attention to the intimate connection between this tree and the entire social and economic fabric of Polynesian culture. The absence of cocoanuts from Peruvian graves he considered a strong argument against an American origin and the Polynesian traditions cited by Dr. Cook, he thought, were due to the fact that the oceanic currents in the mid Pacific set westward, leaving wreckage, etc., upon the eastern coasts of the islands. While agreeing with the speaker regarding the origin of the cocoanut in an arid country and its adaptation to human needs through human agency Professor McGee believed that we are very far from the end of the problem which it presents. Dr. Folkmar also discussed the paper briefly and Dr. Cook made a short reply to the criticisms and questions.

Cannibalism in Polynesia: Arthur P. Rice.

Mr. Rice remarked upon the wide distribution of this custom and the fact that it had survived to modern times more particularly in Polynesia. Within this area, however, great differences are presented. While Fiji is the classic land of cannibalism, the very next group, the Tonga Islands, lacked it entirely; it was a common practise in the Marquesas Islands, but held in abhorrence in Hawaii. In Fiji the custom was a part of the state religion and was demanded by the gods. Revenge upon enemies was the most constant reason for exercising it, but each island kept a black list from which victims were taken on occasion. Those who died a natural death and chiefs were never eaten. Cases were also cited from New Caledonia, the New Hebrides, Samoa and New Zealand. The absence of animals from which a sufficient meat diet could be obtained was cited as a probable stimulant to the great extension of cannibalism over the Pacific, and the modern introduction of such animal diet a contributing cause to its extinction. A partial compensation for the evils of this custom is to be found in the knowledge of human anatomy thereby acquired and the surgical skill resulting, for which the Maori, at least, were noted. The paper was discussed briefly by Dr. Swanton.

The meeting concluded with an exhibition of a collection of Chitimacha baskets recently acquired by the National Museum through Mrs. Sidney Bradford, of Avery Island, La., and an explanation of the designs upon these by the secretary of the society.

John R. Swanton,
Secretary

THE WASHINGTON CHEMICAL SOCIETY

The 190th regular meeting of the society was held at the Cosmos Club on Thursday evening, April 8, President Walker in the chair. The attendance was 57.

Professor F. W. Clarke gave a talk in memory of Professor Wolcott Gibbs. Professor Munroe, Professor Chatard and Dr. Benjamin related some personal reminiscences of the noted chemist.

Announcement was made that a special meeting of the society would be held at the Johns Hopkins University at Baltimore on April 24. The society granted to the American Chemical Society a waiver of jurisdiction over Virginia, except that part of the state within a radius of twenty-five miles from Washington. Dr. F. C. Cook was appointed the delegate to represent the society at the Seventh International Congress of Applied Chemistry at London.

J. A. Le Clerc,
Secretary

Bureau of Chemistry,
Washington, D. C.

SCIENCE

FRIDAY, MAY 7, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE UNTILLED FIELD OF CHEMISTRY[1]

Two years ago, upon a similar occasion, it was my privilege to address many of you and to point out some of the relationships existing between the chemist and the community. In so doing, there naturally devolved upon me the pleasant duty of recalling to your minds a few of the great and more significant achievements of members of our profession by way of indicating, although briefly and most inadequately, something of the extent to which the chemist has already placed the community in his debt. It is good for any body of men, animated by a common purpose, to take, from time to time, mental stock of what they have accomplished and of the relation in which they really stand to their environment. Where, as in our own case, the record is one of which we all may well be proud, its contemplation brings a new sense of the dignity of the work itself, a pride of fellowship and an incentive to increased endeavor.

We move, however, in a world where it is easy to take much for granted, where symbols and conventions quickly come to take the place of the realities they represent. Our mental processes are apt to run along the line of least resistance and the apparent and the obvious obscure the fundamental truths. This being so, we can well afford to leave our achievements in the security of the past while we consider for the moment the things we have left undone.

The volume of chemical literature has become so great, so many compounds have

[1] Address of chairman of the Division of Industrial Chemists and Chemical Engineers, Baltimore, December 29, 1908.

been described and classified, so many methods have been laid down, so much detail confronts the student, and his field of study has been so subdivided as to suggest and foster the delusion that the total sum of chemical knowledge must be vast indeed. Vast in its detail perhaps it is, but lacking in those fundamental unities which out of the confusion of detail bring wisdom. Chemistry still awaits its Newton. It still justifies the estimate of Kant, who said of it more than one hundred years ago:

Chemistry is a science, but not a science in the highest sense of that word; that is a knowledge of Nature reduced to mathematical mechanics.

Despite the immense amount of dry detail which we have accumulated, and in some measure correlated, chemistry is still in the imaginative era where generalizations are more the result of happy inspiration than of close mathematical analysis.

Chemistry concerns itself with the changes which matter undergoes in its varying relations to certain forms of energy and yet we do not know what matter is nor have we any conception of the real nature of energy. One has only to state in their ultimate terms the problems confronting us to bring a realization of how very far from their solution we still stand. They are, for instance, thus summarized by Karl Pearson: *What is it that moves? Why does it move? How does it move?* Where, yet, I ask you is their answer to be found in chemistry?

We have built our science upon the assumption that matter, whatever that may be, is composed of indivisible atoms, of a comfortable and ultimate simplicity, only to find that the atom is in fact divisible and that its structure is undoubtedly complex beyond imagination. As to those phases of energy which are concerned with chemical change, even so great a philosophical chemist as Ostwald says:

Chemical energy is to us the least known of all the various forms, as we can measure neither it nor any of its factors directly. The only means of obtaining information regarding it is to transform it into another species of energy.

So we have gone on for a hundred and fifty years transforming chemical energy into electrical energy or into heat, making minutely refined measurements of the relatively small amounts of energy appearing in our processes, while wholly unconscious all this time of the stupendous stores of potential energy which we now vaguely begin to realize are bound up in matter.

Our study of matter has led us to teach that it manifests itself in some seventy distinct and separate forms which we call elements, and yet our very definition of an element is a confession of our failure. An element is something which we have not been able to decompose into anything simpler. We have discovered some curious and interesting relationships between the elements which point to their common origin. In his heart each one of us believes that they must have had a common origin and that the cycles of development which they exhibit can only have resulted from the action of a periodic variable upon a constant, and yet we very rarely even consider the question of their genesis or why their properties are what they are. We are content to regard them as so many distinct creations. The discovery of a new element is hailed as marking an epoch in the history of our science when our real business should be the elimination of the elements as such.

In their interactions, the elements, as we know them, manifest valences and selective affinities which determine the course of all chemical change, and yet we are without an acceptable working hypothesis of the cause and nature of either valence or chemical affinity. Our ideas regarding the constitution of the molecules of many

compounds have been developed in great detail and have led us to so many happy conclusions which the facts have verified as to justify our belief that these ideas must rest upon a substantial basis of truth. This sometimes leads us to forget that the graphic formulas which we build up and write on a plane surface are an attempt to represent in terms of two dimensions actualities which exist in three. Moreover, these formulas depict the molecule as something fixed and rigid, although everything tells us that the atoms within the molecule are in rapid and ceaseless motion. A new chemistry will dawn when we take proper cognizance of these motions and their influence upon the properties and relations of the compound. We state molecular weights with a finality of assurance, forgetting that we know very little of the molecular weights of liquids and nothing of the molecular weights of solids. We write cellulose as $(C_6H_{10}O_5)_n$ but the unknown n is probably the most significant part of the entire formula.

Sulphur passes before our eyes from the crystalline to the amorphous variety, phosphorus assumes the red or yellow form, and an almost complete change of properties attends the transformation. Carbon exists in several markedly different states, and yet as to the meaning and mechanism of these molecular changes we remain in complete ignorance. Fortunately for the comfort or even the very fact of our existence upon the planet, water is denser at 4° than it is at zero. Had it not been so, our lakes and oceans would be simply so many solid ice masses upon which the summer sun could make only a superficial impression, but, in spite of the paramount importance of the fact itself no one of us can say why the water molecule presents this curious anomaly. We write the water molecule as H_2O and commonly regard it as a relatively simple compound. How then shall we account for the fact that the dielectric constant or specific inductive capacity of water is about fifty times that of air, or perhaps ten times that of glass. As the dielectric constant is in a sense a direct measure of the massiveness of the molecule, are we not forced to the conclusion that the water molecule really is built up of many of these H_2O groups? How else, indeed, shall we explain the power of water to knock asunder the molecules of electrolytes which it dissolves, and does not this complexity of the water molecule bear some relation to the essential part which water plays in the ultimate phenomena of living matter?

And this brings me to the main point of my thesis. A great German chemical company tells us in an attractive book just issued that it employs 218 chemists, 142 civil engineers, 918 officials, and nearly 8,000 workmen. It covers an area of 220 hectares, has 386 steam engines, 472 electric motors, and 411 telephone substations. Its plant represents the highest development which industrial chemistry has reached, but, none the less it can not produce an ounce of starch which a potato growing in the ground fabricates from water and carbonic acid gas under the influence of sunshine.

True it is that this great aggregation of engines and dynamos, furnaces, retorts and stills, can, under the direction of its highly trained and specialized chemical staff, produce certain natural products in condition so available and pure as to even improve upon nature, but by what monstrous effort is it accomplished? In the spring the tender grass and the delicate unfolding leaves cover the whole earth with the green of chlorophyll. There is no noise, no smoke, no stench. The grass is cool and grateful to the touch, and clean. In similar manner vegetation everywhere is fabricating cellulose to the extent of sev-

eral billion tons each year, and not only cellulose, but all the countless other complex products of the vegetable cell. What shall we say of our own chemistry in the face of facts like these, except that we have gone far enough to encourage a faint hope that we may some day be able to approach such methods. Professor Wheeler has defined so clearly a thought which has been in my own mind for years that I can not do better than quote his words. He says:

The vegetable cell is a laboratory in which are carried out a most remarkable series of chemical reactions. As we contemplate the immense number of organic compounds of all degrees of complexity which are formed within this wall of the plant cell we are convinced that this is the chemical laboratory *par excellence*. Two features impress us particularly; first, the silence in which the operations are carried on; second, the narrow range of medium temperatures required. Notwithstanding this apparent simplicity of conditions, the products are of the most various kind. Some of these man is able to synthesize in his own crude way; others are still the secrets of nature. It is utterly impossible for man to prepare certain naturally occurring compounds except at a temperature which would burn the plant tissue. We are led to wonder whether forces exist with which we are unacquainted or whether we are merely unable to control the forces already familiar to us. It would be difficult to say which supposition is the more probable. It will be granted that investigation into the activities of the cell is of profound importance. In fact it has been said that "it is in the plant cell where synthetical operations are predominant, that we have to look for the foundation of the 'new chemistry' which may be expressed broadly as the relation of matter to life."

I expressed two years ago my own belief that the distinctions which we now regard as fundamental between living matter and dead matter would soon break down. This break will, in my opinion, come through the study of the colloids which are the link between matter which we regard as living and that which we regard as dead. At this point, I can not refrain from volunteering a suggestion. We know that the atoms within the molecule are in rotation. It must follow that as the complexity of the molecule increases more and more of its motion of translation must be converted into rotary motion. In the colloidal molecule we know that many simpler molecules are linked together, and in the molecule of living matter, what? May it not be merely that the more or less haphazard and confined movements of the molecules, which together build up the colloid, are in the molecule of living matter coordinated and controlled in a manner which suggests the vortex. Dead matter drawn within this vortex would partake of this movement and exhibit the phenomena of life. Matter thrown off tangentially would resume its rectilinear course and become, for the moment, dead.

When we consider that in theory at least, in which accidents are barred, a tiny bit of living jelly, an amœba for example, can endow with life an ocean of its proper pabulum, it seems obvious that the forces which are to manifest themselves in the phenomena of life are already existent in the pabulum, and that what the living jelly does is to induce a coordination and direction of the atomic movements which then take on the vital aspect. Do we not have something roughly analogous to this in the magnetization of successive pieces of steel drawn across a lodestone? A certain coordination of movement in the molecules of the steel has been induced and magnetism results. So in some manner far more complex life, I believe, may be epitomized as coordinated motion.

The subject-matter of such speculations lies so far outside our present-day chemistry as to almost require apology for their presentation, but they are well within the subject-matter of the chemistry of the future, for, to again quote the words of Pearson:

The goal of science is clear; it is nothing short of the complete interpretation of the universe.

Or as Muir has put it:

The great business of chemistry is to force men into close contact with some aspects of external realities and, with the help of her sister sciences, to remove everything that prevents the full vision of nature.

ARTHUR D. LITTLE

THE FUNCTION AND FUTURE OF THE TECHNICAL COLLEGE[1]

THAT the education of the child through the first eight years of school should be at the public expense is a matter generally accepted as fundamental by every intelligent voter in this country. There are, however, those who insist that public funds should not be used in carrying on schools of secondary rank; and that the expense of college or advanced technical training should be met and universities sustained by the state is a proposition many would combat. The teaching of trades at public expense, a matter that a few years since was considered impossible by trades unions and society generally, is slowly but surely making its way in this country. If we are to witness, in the next decade, such advances in the scientific, commercial and industrial world as would appear commensurate with the progress of the past ten years, it will be largely due to the work of the technical schools, and colleges of science and engineering—institutions under state control as well as those on private foundations.

As the opportunity and field for such institutions are becoming vastly greater and broader and the need for technically trained men more and more apparent, the fact is also clear that the training in such schools is too narrow and restricted. This is but the natural revolt against the old scholasticism. From a college training in letters merely, the tendency has been strongly marked in the opposite direction, and pure science and technique in the abstract has characterized the technical courses.

In these institutions men must be prepared, not alone to carry out the will of another; not simply to be exact machines to execute the plans presented to them. The product of these schools must possess initiative, imagination, individuality; they must be experts, leaders, investigators, executives; they must plan and lead, not follow merely; they must create as well as construct. In other words, continued progress means that technical education must produce executive engineers and industrial experts. For these men of the future we must rely upon the endowed institutions, of which there are all too few of high grade, as well as upon public institutions ranking with the former and offering all the advantages of study and research.

The time will soon be upon us when, forced to sustain a much greater population than we now have, and owing to keen competition with foreign countries, the industrial and commercial development of this nation will demand experts in many lines. The depleting of our forests not only robs us of timber needful in developing the arts, but in certain sections of the country will so affect the water supply as to produce regions dry and arid; the storing of water in reservoirs for purposes of power, consumption and irrigation is a matter hardly yet begun; the building of railroads, canals, electric lines; the bridging of rivers and the draining of swamps; the constructing of a system of highways and thoroughfares from city to city and throughout rural districts; the development of scientific farming, the greatest industry before our people to-day; the building of harbors; the perfecting of our great mining industries; these are some of the enter-

[1] Elaboration of an address before the Technical Education Department of the National Education Association, July, 1907.

prises for which trained men are needed, and the technical school must furnish them.

In using the term "technical college," there is implied a more extended field than that covered by the college of engineering as the latter is generally understood. In its broad aspects the technical college comprehends work in general science, in mechanical, electrical and civil engineering, mining and chemical engineering, hydraulics, architecture, steam, marine and railway engineering, sanitary science, forestry, agriculture, horticulture and the various subdivisions of these comprehensive and inclusive phases of scientific and industrial life.

The very breaking up of any one of these several branches or subjects gives us at once the clew to the necessity for more intensive and more extended work in the departments they represent and shows clearly the necessity for training an increasingly large number of competent men. While many who might pursue technical courses are far removed from the special school, still the duty of extending and carrying on the work must rest in no small degree with these schools, as so few state institutions at present offer adequate courses in these lines.

In the old days before electricity was used as motive power or for purposes of illumination, when building construction was almost entirely with wood, and work in the arts demanded at best small quantities of iron and steel with little stone or brick and no concrete, when work by hand had not been supplanted by the labor-saving mechanical devices, when problems of transportation by land and water, of heating, lighting, water supply, sewerage and drainage, of bridge and road building, of scientific agriculture were as yet undeveloped, the demand for technical education was small. In the mechanical world the civil engineer was the man of the hour. He who could establish a grade or construct a single span was in the front rank. Mechanical and electrical engineering courses, as such, were in embryo. The work of the mining engineer was done by rule of thumb. The "cut and try" method was applied in chemistry and architecture. Sanitary science was in an elementary stage. The study of hydraulics was theoretical rather than applied. Forestry, agriculture and horticulture were carried on in the belief that "nature must take her own course."

But the application of scientific principles in the arts and industries has made possible an evolution that has resulted in a revolution. More and more we have differentiated our lines of work, until what originally appeared to be a field in itself is now broken up, and the expert is he who spends a lifetime upon only one of the problems of a given field of knowledge. As Willam C. Gannett says: "The man of science, and to-day more than ever, if he would add to the world's knowledge, or even get a reputation, must be, in some one branch at least, a plodding specialist."

There is, however, to this argument another side that must be considered. While in an earlier day the work was of a general character, and the special phases of science as yet undeveloped, this very specialization of which we have been speaking has brought about a strong reaction. Constant touch with the special phases of work, concentration upon a comparatively narrow field of human interest, can not but have its effect upon the individual. This fact receives abundant exemplification constantly and illustrations need not be multiplied. Too often we find the technical expert or man of science a technical expert merely. If by nature he is narrow, his training in the schools only tends to enhance this narrowness. Of art or letters, music or drama, he knows little and cares

less. Business is a bore, history a closed book, and he has little in common with society and men and things. As the world develops he knows of this development, if at all, only from the standpoint of the growth of his own science. If he attempts aught outside his field, he fails.

This, then, is the anomaly. That while in the early days of applied science, to be an engineer implied a general knowledge of such principles of the subject as were known, the development of scientific and technical thought and appreciation and the birth of many courses produced extreme specialization. Hence we find the scientific man of to-day troubles himself, not so much with the broad phases of the subject as with a specific part. We have already reached the danger point and the *machine* engineer, the natural result of our present system, must soon be displaced by the *thinking* engineer. The artisan is to go down before the artist-artisan. Thought must take precedence over imitation. The necessity for a broader and more general knowledge upon which the specialty may with safety be constructed, is the argument here being presented.

With this main issue in mind, let us turn for a moment to the consideration of the number of high-grade institutions in this country wherein are offered courses of a technical nature.

A detailed study shows that out of forty-two state universities (the total number in the United States), thirty-six offer technical and engineering courses. Of other colleges and universities of a public, endowed or private character, there are sixty-three offering such courses, while there are forty-five special schools of technology and science; in all a total of one hundred and forty-four institutions offering technological courses.

Of the thirty-six state universities offering these courses, six only may be classed as of the first order. Six of the sixty-three additional colleges rank as first-class institutions, while fourteen of the forty-five special schools of technology are in class one. In this latter number, the Naval Academy at Annapolis and the Military Academy at West Point are included.

Of the six state universities mentioned, all offer courses in electrical, civil and mechanical engineering, three offer courses in architecture, five in chemical engineering, four in agriculture, three in sanitary, two in mining and three in railway engineering, two in metallurgical engineering, one in naval architecture, two in forestry, one in marine engineering, one in irrigation and one in ceramics.

The six additional colleges of public and private nature offer courses as follows: six in electrical, six in civil and five in mechanical engineering, three in architecture, three in chemical engineering, two in agriculture, two in sanitary, four in mining and three in railway engineering, one in metallurgical engineering, two in naval architecture, two in forestry, two in marine engineering and one in horticulture.

In the fourteen special schools of technology, we find nine offering courses in electrical, eight in civil and nine in mechanical engineering, five in architecture, three in agriculture, two in sanitary, five in mining, one in metallurgical and five in chemical engineering, one in forestry, one in railway engineering, one in naval architecture, one in horticulture and one in ceramics.

This gives us a total for the twenty-six educational institutions of twenty-one offering courses in electrical and twenty each in civil and mechanical engineering, eleven each in architecture and chemical engineering, nine in agriculture, seven in sanitary, eleven in mining, seven in railway and five in metallurgical engineering, four in naval architecture, five in forestry, three in ma-

rine engineering, two in horticulture, one in irrigation and three in ceramics.

The combined courses offered by state universities, other public and private colleges, and the special technical schools (one hundred and forty-four institutions) are as follows: ninety-one in electrical, one hundred and thirteen in civil and ninety-four in mechanical engineering, twenty in architecture, fifty-nine in agriculture, fourteen in sanitary, fifty-two in mining, four in marine, ten in metallurgical, thirty-four in chemical and seven in railway engineering, four in naval architecture, four in irrigation, nine in forestry, twelve in horticulture, five in textiles, and five in ceramics.

These facts show the meager opportunities offered for intensive technical work, especially in the light of our rapidly developing resources. The mere fact that there are one hundred and forty-four institutions where education of the character indicated may be had, is not at all an answer to the point made. In most of these institutions calling themselves colleges, and in many of which the traditional subjects are well taken care of, the equipment, the location, the general facilities and the character of the instruction given in technical lines are not such as to fit for leadership or for executive positions, or to equip for expert work, nor are the humanities always so taught as to develop richness of mind.

What has been said of the narrowing influences of courses of study in schools of technology of to-day, applies in greater or less measure to every such institution in the country. Even those of greatest reputation are not free from this criticism. Some of these colleges are breaking the bonds of tradition and are broadening their curricula. The fact remains, however, that if we are to equip, *not machines, but men*, if the product of the school is to be first a man and then an engineer, it follows that the conservative measures of the past must be disregarded and that we must demand a more logical treatment of our technical college schedules.

That the training given in the technical college be not over narrow and restricted, to the science, mathematics, drawing and shop work must be added such of the humanities as experience may show to be essential. The graduate of an engineering college or of a school of technology frequently finds himself in possession of sufficient facts connected with his profession, but with a knowledge of the language he uses so inadequate as to seriously handicap him in pursuing his vocation. The business side of his education he also finds, when too late, has been sadly neglected. To adequately express oneself and to perfectly understand all business forms, such as papers of conveyance, deeds, bills of lading, etc., are matters to be ignorant of which is absolutely inexcusable. Details of common law, training in questions of national and political economy, of general history and of commercial geography are fundamentally essential.

Herein is where the failure is so often made. The specialist can perform the task allotted to him, he can construct the plant, install the equipment, but can go no further. The management of the enterprise, the business side of the project, he can not grasp. For this purpose a business man is required, and the latter, having no acquaintance with the technical features involved, makes failure of his administration. The engineer must be an executive engineer. His training must be such as to enable him to tie together the various specialties. He must understand accounting and know how to make proper apportionments; in other words, he must be familiar with the commercial phases of his profession; he must have a knowledge of business methods, of political and economic conditions, of the development of trade and in-

dustry. He must know thoroughly the commercial side of his problem.

But if technical courses are thus broadened, adjustment must be made somewhere. No more can be crowded into the four years now required for graduation from a technical or engineering school. Must, then, these additional lines of work be demanded of technical students, and if so, how shall the schedules be adjusted?

Three alternatives present themselves as partial answer to the last question. First, the lengthening of the professional course to five or six years, making it graduate in character and on a par with graduate or professional schools of medicine or law. Second, the adding of two years to the present high-school courses now preparing for advanced technical work, thus enabling students to enter the technical college upon a much better foundation than at present. Third, the elimination of the non-essentials from the present four years' courses, thus leaving more time for additional necessary work.

The argument advanced by advocates of the first method is that the four years of regular college work is not sufficient. That to be adequately trained implies ultimately the lengthening of the college course to five or six years. Each year brings a greater store of knowledge to be taught and with this additional knowledge comes the understanding that to push the man through his course is to start him on the road to inefficiency. Especially must those who are to be leaders, the "trail blazers," the executives, the experts, be given advantage of a longer course.

The claim is made that after eliminating the non-essentials there will not be sufficient time in which to present the subjects of the special line being pursued and such of the humanities or so-called culture subjects as were previously suggested. English alone must be granted considerable time, as an appreciation of good literature, a taste for the best that has been written, is essential to growth, whoever the man and whatever his profession. The student who in school and regardless of his trend of thought, is not given the opportunity of putting himself on friendly terms with the best in literature, is being robbed of one of the tools most necessary to advancement, and an element of the greatest pleasure and profit. On the other hand, so much must be added each year, as the discoveries and developments in science are made, that these alone may more than compensate for the eliminations.

Considering the second point, it would seem that there are many and strong arguments in favor of the lengthening of the high-school course to six years, such arguments applying with equal force to both traditional and manual-training high schools. But the lengthening of the preparatory course implies at once one of three alternatives. (1) A six-year preparatory course, in which the subjects are of secondary grade, without regard to lengthening of the college course thereafter. (2) A six-year preparatory course wherein certain preliminary college work is taken up, the regular college course to be either two years or four years in length. (3) A six-year course to be followed by a six-year college course. These propositions will receive no extended consideration at this time.

If the proper equipment and courses could be supplied in the high school, the students had better spend six years therein, as many who seek the technical and engineering college are so immature as to be unable to adjust themselves to the changed atmosphere, and go down and out in the first few weeks of school. Many have not found their level on leaving high school and are not adapted to the work to which they aspire. At much less expense than at

foods and drugs are prepared, sold or offered for sale. This is in line with the recommendations of the State and National Food and Dairy Departments.

3. An amendment to the Water and Sewage Law was passed, revising the definition of sewage so as to include industrial wastes, and giving the Board of Health authority over the operation, as well as the installation of both old and new water plants and sewage systems, also, providing for investigations concerning purity of water supply and the pollution of streams.

4. A comprehensive and stringent Weights and Measures Law was passed, authorizing the inspectors of the Food and Drugs Department to be inspectors of weights and measures, and charging them to assist in the enforcement of the law.

5. There was passed what is believed to be an effective hotel inspection law, with special attention to fire escapes, sanitary conditions, cleanliness, disinfection of rooms and sanitary supervision over places where foods are prepared.

6. Four important laws were passed, looking toward tuberculosis control in the state. One of these laws requires compulsory confidential reports of all cases; another is intended to control tuberculosis in animals; another refers to spitting in public places; and a fourth appropriates $10,000 a year for an educational campaign for the supervision and prevention of tuberculosis.

7. A law was passed revising the general health laws, pertaining to health officers, and among other things empowering the State Board of Health to remove a county health officer for neglecting, or refusing, to perform the duties of his office.

This legislation will add very much to the powers already possessed by the State Board of Health, and they will be able, to a greater extent than ever before, to contend effectively with disease. E. H. S. Bailey

IN OKLAHOMA

The following is from the *Oklahoma City Times* of April 23:

Despite the fact that all the business transacted by the board of regents of the Oklahoma Agricultural and Mechanical College at Stillwater in its meeting April 13 to 15, has been kept secret, the fact has leaked out that the board decided on a wholesale dismissal of instructors.

As a result of the dismissals many are declaring that the action was taken in order that firmer supporters of the Haskell state administration might be elevated to positions which carry good salaries.

It is known that ten of the instructors in the schools have received notice of their dismissals, and that the new selections of the board will soon be named for their places.

Among those who have been dismissed are:

George H. Holter, professor in chemistry, who has held his position in the school with credit for seventeen years.

O. M. Morris, professor in botany and horticulture, who is a graduate of the school, class of 1896 and who graduated in his specialties from Cornell in 1897.

E. E. Balcomb, who is in charge of the agricultural work, which the school provides for the common schools of the state. Professor Balcomb was appointed by the same board last year.

James W. Means, professor in mathematics.

R. Rosensteingel, assistant in electrical engineering.

C. Beathy, in charge of chemistry in the experiment station. He is one of the appointees of the present board.

J. F. Lawrence, instructor in mathematics.

R. P. Sauerhering, assistant in mechanical engineering.

H. S. Weatherby, assistant in chemistry.

Miss C. H. Snapp, instructor in English, one of the board's own appointees.

It is reported that the board of regents of the university has resolved to confer the degree of doctor of laws on Mr. Linebaugh, the regent, at whose request the notorious letter from the Rev. Mr. Morgan was written accusing members of the faculty of dancing and card playing. The board has passed the following resolutions:

Whereas, the University of Oklahoma belongs to all the people of the state and should be conducted in such a way that the humblest citizen can not justly criticize it or any member of the faculty, and

Whereas, a goodly number of our citizens very

seriously object to members of the faculty engaging in the public and indiscriminate dance and card parties;

Therefore, be it resolved by the board of Regents, in regular session in the city of Norman, April 2 and 3, 1909, that we request the members of the faculty of this university to refrain from these amusements during their connection with this university.

Resolved further, that the president of the university be requested to furnish each member of the faculty with a copy of this resolution.

BUILDING FOR SCIENTIFIC, EDUCATIONAL, PATRIOTIC AND OTHER ORGANIZATIONS IN WASHINGTON

AT the meeting of the National Academy of Sciences on April 21, 1909, the question of the lack of proper accommodations in the Smithsonian building for the National Academy, the American Association for the Advancement of Science, and other national and local scientific organizations was brought up by the Secretary of the Smithsonian Institution.

Secretary Walcott explained that the headquarters of the National Academy, the American Association for the Advancement of Science and the American Historical Association are in the Smithsonian Institution building; that three other bodies have applied for space, but there is no more room available and there is no place in Washington available for large scientific gatherings, such as would come together at meetings of the American Association for the Advancement of Science, and scientific congresses on various subjects. There will be better facilities in the new National Museum building, but there will be inadequate facilities for large meetings and congresses. He then called attention to the memorial building proposed by the George Washington Memorial Association. The general scheme as outlined by the association is to erect a great memorial building to George Washington in recognition of his strong desire expressed in his farewell address: "Promote then, as an object of primary importance, institutions for the general diffusion of knowledge"; also, "the promotion of science and literature."

The memorial association circular states that the building

> will be dedicated to the increase and diffusion of knowledge in all lines of human activity that will conduce to the advancement of the welfare of mankind.
>
> The building is to be well located, attractive in appearance, practical in plan and construction, and of the most durable character. It is to be planned so as to furnish a home and gathering place for *National, Patriotic, Scientific, Educational, Literary and Art Organizations* that may need such accommodations, including the Washington Academy of Sciences and its sixteen affiliated societies. It will furnish a place where all the Patriotic Societies both north and south may testify to their love for the Father of this Country. The building will contain a great hall or auditorium and rooms for large congresses, such as the recent Tuberculosis Congress; rooms for small and large meetings; office rooms and students' research rooms.

Primarily the basis of this movement is a patriotic one. The nation needs a headquarters for its great national organizations engaged in bringing the people in closer touch with each other, in all that pertains to patriotism and increase of knowledge that will make better and stronger men and women, physically, mentally and morally.

All the national and local organizations mentioned may have their offices in the proposed building and be liable only for their personal expenses, as it is planned that an endowment fund for the maintenance of the building shall also be collected.

The George Washington Memorial Association has $25,000 in its permanent fund and $5,000 for expenses. It is planning to organize in every state through state chairmen and to obtain funds by contributions of one dollar or more.

The memorial association recently elected Mrs. Susan Whitney Dimock, of New York, president, and the following advisory council has been appointed: Hon. Elihu Root, President Ira Remsen, Professor H. Fairfield Osborn, General Horace Porter, President Chas. J. Dabney, Dr. Charles D. Walcott, Mr. Charles J. Bell.

Mr. Charles J. Bell is the trustee of the permanent fund.

It was further explained that the memorial association is not working under an agreement with any educational or other institution but that it desired the cooperation of all organizations and individuals interested in its purpose.

After full consideration the National Academy of Sciences unanimously adopted the following resolution:

Resolved, That the National Academy of Sciences give its approval to the general plan of the George Washington Memorial Association to collect funds for the purpose of erecting and maintaining in the city of Washington a building adapted for a meeting place of scientific organizations.

The Washington Academy of Sciences has had the matter under consideration for some time through its building committee. On April 20 its board of managers recommended active cooperation with the memorial association and at a meeting of the academy, April 24, the following resolutions were adopted:

Resolved, that, in the opinion of the Washington Academy of Sciences, the efforts of the George Washington Memorial Association to provide suitable facilities in the city of Washington for bringing together the national patriotic, scientific, educational, literary and art organizations that may need such accommodations, including the Washington Academy of Sciences and its affiliated societies, deserves commendation and support.

Resolved, that the academy considers it eminently desirable that we should commemorate the interest felt by our first president in science and the higher education, and that no better method can be found than to provide, in the city which bears his name, the capital of the nation, a suitable meeting place for all engaged in the advancement of the welfare of the human race.

Resolved, that the academy appoint a special committee to cooperate in this important movement by all practicable methods.

Resolved, that the academy recommends to each of the affiliated societies that it appoint a similar committee to cooperate with the committee of the academy.

The Washington Academy has appointed its building committee, Dr. George M. Kober, chairman, as its effective agency to take the matter up with the members of the academy and affiliated societies and the citizens of Washington.

SCIENTIFIC NOTES AND NEWS

Professor George E. Hale, Mount Wilson; Professor Santiago Ramón y Cajal, Madrid; Professor Émile Picard, Paris, and Professor Hugo Kronecker, Berne, have been elected foreign members of the Royal Society.

The following new members have been elected to the American Philosophical Society: Louis A. Bauer, William Howard Taft, Washington, D. C.; Marston Taylor Bogert, Hermon Carey Bumpus, Dr. Alexis Carrel, A. V. Williams Jackson, New York; Edwin Brant Frost, Williams Bay, Wis.; Robert Almer Harper, Charles Richard Van Hise, Madison, Wis.; William Herbert Hobbs, Victor Clarence Vaughan, Ann Arbor, Mich.; Abbott Lawrence Lowell, Boston; William Romaine Newbold, John Frederick Lewis, Charles Bingham Penrose, Philadelphia; Francis Darwin, Cambridge, England; Hermann Diels, Emil Fischer, Berlin; Friedrich Kohlrausch, Marburg; Wilhelm F. Ph. Pfeffer, Leipzig.

M. Pierre Termier, professor of mineralogy in the Paris School of Mines, has been elected a member of the Paris Academy of Sciences in the place of the late M. Gaudry.

Professor Wilhelm Ostwald, the eminent chemist, has been awarded by the University of Christiania its first Cato M. Guldberg medal.

Subscriptions to the Charles W. Eliot fund have been received from about 2,050 graduates of Harvard University and others, and amount at this time to about $130,000. The subscribers have sent subscriptions as follows: 858, $5 and under; 500, $10 to $20; 418, $25 to $50; 189, $100 to $250; 58, $250 to $500; 31, $1,000 to $10,000. The committee hopes that the fund will amount to more than $150,000 by May 10, when President Eliot retires. The subscriptions have been placed in the hands of trustees, to invest and hold for the benefit of President and Mrs. Eliot. The fund will eventually pass to Harvard University.

Dr. Eugen Wolf has been promoted to the directorship of the Senckenberg Museum of

Natural History at Frankfort, in succession to the late Dr. Roemer.

DR. PAUL POPPENHEIM has been appointed custodian in the Zoological Museum at Berlin.

MR. JOHN HEWITT, of Jesus College, Cambridge, has been appointed assistant for molluscs and fishes at the Transvaal Museum, Pretoria. For the last four years Mr. Hewitt has been curator of Rajah Brooke's Museum at Sarawak.

DR. RICHARD PRAGER, of Berlin, has been appointed head of the computing division, and Dr. Walter Zurhellen, of Bonn, head of the astrophotographic department in the Observatory of Santiago de Chile.

DR. EDWARD R. WALTERS has been appointed director of the Department of Health and Charities at Pittsburg.

PROFESSOR WILHELM HITTORF, the eminent physicist of Munich, has celebrated his eighty-fifth birthday.

DR. H. GRENACHER, professor of zoology at Halle, has retired from active service.

PROFESSOR A. LAWRENCE ROTCH, director of the Blue Hill Observatory, has returned from attending the International Aeronautical Commission at Monte Carlo.

DR. MAXIME BÔCHER, professor of mathematics at Harvard University, expects to spend the coming academic year abroad.

PROFESSOR H. E. CRAMPTON, of Columbia University and the American Museum of Natural History, will take his fourth voyage to the Society Islands this summer. Later he will go by way of Cook's Islands to New Zealand and the Samoan group via the Tonga Islands. He will return by way of the Fiji Islands and Hawaii, arriving home in January, 1910.

THE advanced students of geology at the University of Wisconsin left on April 30 for a ten days' trip through the iron and copper districts of Wisconsin, Minnesota and Michigan. Accompanied by Professors C. K. Leith, E. C. Holden and A. N. Winchell, they will be joined en route by Professor More, of Chicago, and a group of Chicago students; by Professors Mansfield, Cline and Sauer, of Northwestern and their students; and by a member of the Canadian Geological Survey, Mr. Collins, of Ottawa, Canada. Starting from Duluth, the party will go through Tower and the Vermilion range; Biwabik and the Mesabi range; Carlton, Minn.; Houghton, Mich.; Ishpeming and the Marquette district, returning to Madison May 10.

PROFESSOR WM. A. LOCY, of Northwestern University, delivered the principal address before the Iowa State Academy of Science at Iowa City on the evening of April 30. His subject was "The Service of Zoology to Intellectual Progress."

DR. ALEXANDER GRAHAM BELL was announced to read on the evening of May 7 before the American Philosophical Society a paper on "Aerial Locomotion."

PROFESSOR WALTER R. CRANE, of the Pennsylvania State College, will read a paper on "The Use of Concrete in Mine Support" before the Institution of Mining Engineers meeting in London on May 28.

PROFESSOR GEORGE B. FRANKFORTER, dean of the college of chemistry at the University of Minnesota, lectured at the University of Wisconsin on April 30 on "Utilization of Waste Products from the Lumbering Industry."

PRESIDENT CHARLES R. VAN HISE, of the University of Wisconsin, has announced a course of instruction to be given next year in the geological department, on the conservation of natural resources. Dr. Van Hise's administrative duties have until now prevented his resuming teaching.

IN the fern herbarium of the New York Botanical Garden, which is now officially called the Underwood Fern Herbarium, a bronze tablet in his memory has been erected bearing the following inscription:

THE
UNDERWOOD FERN HERBARIUM
NAMED IN HONOR OF
LUCIEN MARCUS UNDERWOOD
1853–1907
CHAIRMAN OF THE SCIENTIFIC DIRECTORS
1901–1907

IN memory of the late Professor Mendeleef, it is proposed to establish in St. Petersburg a

Mendeleef Institution to contain chemical and physical laboratories and a museum.

Dr. Alexander Krakau, professor of electrochemistry at the University of St. Petersburg, died on March 29.

The death is also announced of Professor F. E. Hulme, professor of mechanical drawing at King's College, London, and the author of several well-known books on wild flowers.

The Society of German Chemists will hold its annual meeting at Frankfort from September 14 to 18.

Under the provisions of the program of administrative reform in preparation for constitutional government, the ministry of the Interior of the Chinese Empire has issued regulations governing the taking of a census of all Chinese, both at home and abroad. There will be a census of families and also of individuals. The former is to be completed in 1910 and the latter not later than 1912.

The Academy of Science of St. Louis is bringing together an endowment fund of $15,000, the income from which is to ensure continued publication of its long-established *Transactions*. To an invested fund of $3,000 the council has added $1,000 from the treasury and members have contributed an additional $2,500. Of the remaining $8,500, $5,000 have already been subscribed.

Over a ton and a quarter of rare earths has been presented to Professor Victor Lenher, of the department of chemistry of the University of Wisconsin, by the largest manufacturer of gas mantles in this country. The gift was made in recognition of the work on those substances which has been carried on for some years by Professor Lenher. The greatest quantity of monazite sand, which contains the rare earths in crude form, is found in North Carolina, the source of supply for all North American manufacture of gas mantles, as Brazil is the source for European manufacture. In the form of a by-product of gas mantle manufacture, the earths look like white flour, and it is in this form of oxalates that the 2,500 pounds given Professor Lenher are stored in barrels in the chemistry building of the university. A number of graduate students at the university, under the direction of Professor Lenher, are devoting their efforts to various investigations of the rare earths. Three of these, Professor C. W. Stoddart, of the soils department of the agricultural college; Professor Raymond C. Benner, of the University of Arizona, who took his degree of master of arts at the University of Wisconsin in 1905; and Charles W. Hill, assistant in chemistry at the university, are at present making such investigations the subject of their dissertations for the doctor's degree.

According to the *Westminster Gazette* the late Mr. John Murdock, who resided at Craiglockhart, in the county of Midlothian, by his will directed his trustees to employ the residue of his estate "in instituting and carrying on a scheme for the relief of indigent bachelors and widows, of whatever religious denomination or belief they may be, who have shown practical sympathy either as amateurs or professionals in the pursuit of science in any of its branches, whose lives have been characterized by sobriety, morality and industry, and who are not less than fifty-five years of age." The trustees notify that they are prepared to grant donations or pensions to persons "who have done something in the way of promoting or helping some branch of science" and who otherwise conform to the requirements of the trust.

We are requested to state that the Royal Observatory of Belgium at Uccle is arranging to publish a list of the magnetic and seismological observatories of the world, together with a list of societies and reviews concerned with terrestrial magnetism, atmospheric electricity and seismology, and that information that will make these lists as complete as possible will be gladly received.

Mr. J. H. Gregory, '50, of Marblehead, has presented to Amherst College some 1,500 Indian implements, which include specimens from South Carolina, the Connecticut Valley and Marblehead. This collection consists largely of spears, arrowheads, hatchets and other implements of the southern Indians col-

lected by Mr. Gregory nearly fifty years ago, when he was a student at a theological seminary in South Carolina.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Washington, Seattle, will receive by appropriation of the state legislature the sum of $673,000 for maintenance, for the biennium, 1909–11. Four permanent brick structures: an auditorium, a chemical laboratory, an engineering building, a power plant; and two semi-permanent structures: a library and forestry building will lapse to the university after being used by the Alaska-Yukon-Pacific Exposition, this summer.

MR. ANDREW CARNEGIE, in commemoration of twenty-five years' work in bacteriology and pathology done by the Carnegie Medical Laboratory of New York University, has given $75,000 to the school. The money will be applied to the extension of the present Carnegie Laboratory building by an addition to it, which will face on First Avenue, the present building fronting on East Twenty-sixth street.

THE legislature of Nebraska in its recent session appropriated $20,000 for the purchase of a new site in Omaha for the college of medicine of the University of Nebraska. The citizens of Omaha are to erect the buildings on the site thus obtained. The hall of mechanical engineering of the university is approaching completion and will be ready for occupancy in September. At a recent meeting of the regents the sum of $50,000 was set aside for equipment. The regents are taking steps to locate two additional experiment sub-stations, as provided by the recent legislature. One of these is to be in the "Sandhill Region" of central Nebraska, and the other in the "Irrigation Region" of the western part of the state. They are contemplating considerable additions to the campus by the purchase of adjacent property. This has been made necessary by the present overcrowded condition of the campus. The tuition fees hitherto required of graduate students who are not residents of the state have been abolished.

THE Boston *Evening Transcript* states that plans are maturing for the establishment of a medical school in China. The promoters are Harvard men who intend to go to China at the expiration of their hospital appointments, having definite invitations from his excellency the viceroy of the Kiang Soo province. An endowment fund will be raised to be held by a board of trustees in this country, incorporated to direct the financial affairs of the institution. President Charles W. Eliot, of Harvard, has consented to serve as chairman of this board, and his associate trustees will be Dr. H. P. Walcott, Dr. A. T. Cabot, Dr. W. T. Councilman, Dr. W. B. Cannon, Dean H. A. Christian and Professor E. C. Moore. These are the men who intend to go: Drs. J. P. Leake, W. S. Whittemore, W. H. Hitlner, I. Hartshorn, C. C. Haskell, M. R. Edwards, A. L. Patch, A. M. Dunlap, G. P. Gaunt and C. A. Hedblom.

A DESPATCH from Denver to the daily papers says: "Differences between the members of the faculty and the board of trustees of Westminster University, Denver, Col., a Presbyterian institution, arising out of a general reduction of instructors' salaries, have resulted in the dismissal of President Joseph L. Weaver and the entire faculty. The reduction caused President Weaver and the faculty to bring suit for back pay, and the dismissal followed."

DR. WILLIAM A. SHANKLIN will be inaugurated as president of Wesleyan University on October 29. He will, however, assume the duties of the office after the close of the present academic year.

DR. CHARLES E. BESSEY, who has been for many years the dean of the industrial college of the University of Nebraska, has been promoted to be head dean of the university. He is chairman of the board of deans, and becomes the acting chancellor whenever the chancellor is absent or indisposed.

MR. C. T. BRUES, curator of invertebrate zoology in the Milwaukee Public Museum, Milwaukee, Wis., has been appointed instructor in economic entomology at the Bussey Institution of Harvard University.

Dr. J. Frank Daniel, late at Johns Hopkins University, now working at the Pasteur Institute at Lille, France, has been appointed instructor in zoology at the University of Michigan, to succeed Dr. Dana B. Casteel.

Dr. Emil Bose, of Danzig, has been appointed professor of physics in the University of La Plata.

Professor J. Bauschinger has been appointed to succeed Professor E. Becker as professor of astronomy and director of the university observatory at Strassburg.

Dr. Einar Hertzsprung, of Copenhagen, has been appointed associate professor of astronomy and astrophysics at Göttingen.

DISCUSSION AND CORRESPONDENCE

INDUSTRIAL FELLOWSHIPS

The incidental reference made by Professor Kipping in his address before the British Association to a scheme of industrial fellowships which I have initiated in this university has led to so many inquiries from industrial chemists and to such general interest that I am compelled to present now its main outlines and present status rather than to wait, as I had intended, until its material results had determined fully its practicability. The scheme was initiated through an article entitled "Temporary Industrial Fellowships" which was published in the *North American Review* for May, 1907. This article was subsequently included as the last chapter in a book called "The Chemistry of Commerce" (Harper's). The scheme as then evolved has developed as I gained experience into something somewhat different; while it is essentially the same, I have found it practicable to claim on behalf of the university more advantages than I at first thought possible. Perhaps the present nature of the scheme is better exemplified in one of the later fellowship agreements, for example in Fellowship No. 7:

For the purpose of promoting the increase of useful knowledge, the University of Kansas accepts from the A. B. C. Glass Company, having head offices at New York, the foundation of a temporary industrial fellowship to be known as the A. B. C. Fellowship.

It is mutually understood and agreed that the conditions governing this fellowship shall be as follows:

The exclusive purpose of this fellowship is an investigation into the optical properties of glass in relation to its chemical constitution, to the furtherance of which the holder shall give his whole time and attention, with the exception of three hours a week, which he shall give to work of instruction in the chemical department.

The fellow shall be appointed by the chancellor of the university, the director of the chemical department and the professor of industrial chemistry; he shall have made previously a reputation in research; he shall be a member of the university, and shall pay all regular fees with the exception of fees for laboratory and supplies, for which his instruction shall be taken in lieu, unless in the opinion of the appointers his demands become excessive, in which case the donor shall be expected to reimburse the university; he shall work under the advice and direction of the professor of industrial chemistry; and he shall forward, periodically, through the professor of industrial chemistry, reports of the progress of his work to the A. B. C. Company.

For the support of this fellowship, which shall extend through a period of two years from the date of appointment of the fellow, the A. B. C. Glass Company agrees to pay fifteen hundred dollars ($1500) per year, payable annually to the university on the date on which the fellow begins work at the university. This sum shall be paid by the university in monthly installments to the holder of the fellowship.

Any and all discoveries made by the fellow during the tenure of this fellowship shall become the property of the A. B. C. Glass Company, subject, however, to the payment by them to the fellow of ten (10) per cent. of the net profits, to be commuted at the desire of either party through the arbitration provided for herein, arising from such discoveries, it being understood that the fellow shall be regarded as the inventor. At any time during the tenure of his fellowship the holder shall, at the option of the donor, take out patents at the expense of the donor on condition that at the time of making application therefor he shall assign his right to the donor under the conditions of this agreement. At or before the expiration of the fellowship, the business services of the fellow may be secured by the A. B. C. Glass Company for a term of three years on condition that the terms of such services are satisfactory to both parties at interest.

In the event of any disagreement between the donor and holder of this fellowship, it is understood and agreed that the chancellor of the university, or one whom he may appoint, shall act as arbiter as to all matters of fact, that his decisions shall be binding upon the parties at issue, and that they shall obtain such decision before having recourse to the courts.

It is also understood and agreed that during the tenure of this fellowship the holder may publish such results of his investigation as do not, in the opinion of the company, injure its interests, and that on the expiration of the fellowship the holder thereof shall have completed a comprehensive monograph on the subject of his research, containing both what he and others have been able to discover. A copy of the monograph shall be forwarded to the A. B. C. Company, and a copy shall be signed and placed in the archives of the university until the expiration of three years from that date, when the university shall be at liberty to publish it for the use and benefit of the people.

Signed on behalf of the University of Kansas.

....

Date ....

Signed on behalf of the A. B. C. Glass Company.

....

Date ....

There have been so far accepted by the university the following fellowships:

1. An Investigation into the Chemistry of Laundering, having for its object an improvement which will save in some measure laundered fabrics. It yields $500 a year, together with 10 per cent. of the net profits.

2. A Search for a New Diastase. The present source of the best diastase is expensive. The investigation has as a matter of fact developed into an attempt to make a new fodder upon scientific principles. It yields $500 a year and, under the original agreement, 10 per cent. of the gross proceeds for three years.

3. An Attempt to Utilize the Constituents of Waste Buttermilk, which, at present, in butter factories goes down the drains. These constituents, which it is desirable to conserve, are primarily caseine, and secondarily, lactic acid and sugar of milk. The fellowship yields $500 a year and ten per cent. of the net profits.

4. An Investigation into the Chemistry of Baking. This investigation was established by the National Association of Master Bakers, with the object not only of improving the chemistry of bread, but, as well, of providing for the association a trained expert upon whom they could afterwards rely. It yields $500 a year, together with a lump sum to be settled by arbitration, if necessary.

5. An Investigation into the Constituents of Crude Petroleum. I can not with propriety state the precise object of this investigation. The fellowship yields $1,000 a year and 10 per cent. of the net profits.

6. An Attempt to Improve the Enamel upon the Enamel-lined Steel Tanks used in all kinds of chemical operations on a large scale. This fellowship was established by the largest manufacturer of these tanks in the world. It yields $1,300 a year, together with an additional consideration to be decided upon, for the service rendered, by the chancellor of the university or one whom he may appoint.

7. An Investigation into the Relation between the Optical Properties of Glass and Its Chemical Constitution. This fellowship yields $1,500 a year and 10 per cent. of the net profits.

8. The Discovery of New Utilities for Portland Cement and of Improvements in Its Manufacture. This fellowship yields $1,500 a year and a large additional consideration dependent upon success.

The fellows for Fellowships Nos. 7 and 8 have not yet been selected. In addition to the foregoing fellowships there are certain others assured but not yet established:

9. An Investigation into Certain Glands of Deep-sea Mammals. It yields $1,500 a year and an additional consideration to be decided upon by arbitration. This fellowship is to be a benefaction.

10. The Discovery of New Utilities for Ozone. It yields $2,000 a year and 10 per cent. of the net profits.

The tenure of all fellowships is two years.

It is regrettable that in accordance with the terms of the agreement, it is impossible to publish at this time the results so far obtained. It may be said, however, that the progress of the fellows has been gratifying. It is significant in this connection that Fellowship No. 1, which expires shortly, is to be continued at *double the value* for three months, at the end of which time the donors will either take the fellow and his process into the factory or they will continue his fellowship through a third year at the increased amount; while with Fellowship No. 2 the donors have already indi-

cated their intention to continue it throughout a third year; the progress of the others has exceeded that of the first two and has surpassed expectations.

Most of these fellowships have arisen through letters of inquiry from the various companies. I have not gone out seeking fellowships in general. Had I done so it is not unreasonable to suppose that by this time there might have been from thirty to fifty. Owing to the fact that these fellowships have no relation to ordinary fellowships and that the scheme is essentially a new one, it has been deemed advisable to establish them at intervals. Proceeding in this way, and learning as one went, the scheme has undergone a natural and advantageous development. The degree to which it has been systematized, its effect upon the chemical department, the results of the relations of the different researches and reseachers to one another, and the wholly unexpected interactional relation of the donating companies to one another I shall reserve for a future communication. While it should be said that as yet this scheme of industrial fellowships is wholly experimental and tentative, it ought also to be said that the two years' experience has not shown that it is any other than a sane and practical relation between the university and industry to the advantage of all concerned.

Robert Kennedy Duncan
University of Kansas,
April 10, 1909

ELEMENTARY EMBRYOLOGY COURSES

The publication of Professor Lillie's "Development of the Chick," and the excellent character of his treatment of the subject, suggests comment upon the custom of using the chick for introducing students to embryology. Since the days of von Baer and before, the chick has been used for embryological study more than any other form. This has probably been due in part to its familiarity and to the ease of obtaining embryos of any desired age. Foster and Balfour's very valuable, though poorly written, "Elements of Embryology," based on the chick, for so long the only available text-book for immature students, fastened more firmly the custom of using the chick in introductory embryological courses. Now comes Lillie's fine treatment of the same subject, which is likely to establish the chick in almost undisputed possession of these courses.

Chick embryos are easy to obtain and easy to manipulate and much has been written about them; they also have decided resemblance to human embryos. Yet in spite of these advantages I can not but feel that chick embryos are peculiarly ill-adapted to the use of students beginning the study of embryology. The embryo chick is a highly specialized form adapted to a very peculiar environment within an egg shell and still further distorted from the general vertebrate type by the presence of the huge yolk mass. These special adaptations are of great interest, but it has been my experience that they assume an undue prominence in the minds of students and prevent their readily grasping the general phenomena of development of vertebrates, unless some less specialized form, as for example, the frog, has first been studied.

The first three years I taught elementary embryology we began with the chick and used it chiefly, if not exclusively. Since then, each year, after a brief consideration of the cell, its organs, and its behavior in mitosis, and a rapid survey of cleavage and gastrulation in half a dozen forms, we have taken up the embryology of the frog, using Marshall's "Vertebrate Embryology," modified and supplemented, of course, by the lectures. The laboratory work has covered the same ground as the classroom work. After completing the study of organology in the frog, two weeks to four have been given to the chick and two or three lectures to comparisons with the development of mammalia.

The point I would like to emphasize is that I have found that the students in these later courses got a far better grasp of the embryology of the chick in two weeks' study following careful work upon the frog, than they ever succeeded in obtaining when they began with the chick and devoted all the time to this subject, and of course they got a far more adequate conception of the embryology of verte-

brates. The difference in the results obtained by the two methods has been so great that I could not be induced to return to the former method. The course of the second type has, in its results, utterly outclassed that of the first sort at all points, even in pure training in observation, for observation must include a conception of the adaptations in the phenomena observed. Even students who plan to study medicine are, I am sure, far better prepared to study with intelligence human embryology than if they had given their attention wholly or chiefly to amniote embryos in which the space relations of the organs are so distorted by secondary influences.

Material for the elementary cytological work and the study of cleavage and gastrulation is easy to prepare and also can readily be purchased, and there is no difficulty, of course, in obtaining frog embryos and larvæ. The yolk in the earlier embryos necessitates careful work in preparing sections, but, by avoiding absolute alcohol and by using an oil that does not make the yolk too brittle, good preparations are readily obtained. The labor of preparing sections of frog embryos and larvæ seems no greater than that of preparing chick sections. At any rate, the labor is not such as to lead one, in order to avoid it, to choose less instructive material for study.

Perhaps no clearer text-book has ever been written than Marshall's "Vertebrate Embryology." In spite of some inaccuracies, and of not being up to date, it is still usable, but its cost is considerable, and it contains more than most introductory embryological courses can cover. Holmes's volume, "Biology of the Frog," gives insufficient treatment to the embryology, and Marshall's little book, "The Frog," is no more adequate on this side. Morgan's "Development of the Frog's Egg" is not adapted for an introductory embryological course. We greatly need an embryology of the frog. A revision of Marshall's chapters on this subject, and their publication as a separate volume would well meet this need. Were there such a volume obtainable, one would not fear harm from the publication of Lillie's "Development of the Chick," for courses of each type would then have a satisfactory text-book and an unbiased choice would be possible; but under present conditions one does fear that the very excellence of Lillie's book will serve to perpetuate an unfortunate tradition and will delay the general coming of embryological courses that are a better preparation for general morphological study.

M. M. Metcalf

THE COUNTRY BOY AGAIN

In Science, February 12, in discussing industrial education, I made the statement that with only 29 per cent. of our population actually living on the farm, with miserably poor school facilities as compared with our city population, this 29 per cent. furnishes about 70 per cent. of the leaders in every phase of activity in this country. This statement was quoted from memory and was in error to the extent that I should have said 29 millions of our population instead of 29 per cent. Dr. Frederick Adams Woods, in Science, April 9, quotes this statement and adds some criticisms.

First, I want to assure Dr. Woods that I appreciate very fully the magnificent work he did in his study of heredity in royalty. It fell to my lot to review Dr. Woods's book, and I found it one of the most interesting treatises on heredity we have. He has demonstrated, I think, beyond cavil, that "native ability and natural impulses of human beings are as much a matter of heredity as are any physical characteristics."

The above quotation is from my review of Dr. Woods's paper in my article on Mendel's law, which will appear soon in Volume V. of the American Breeders' Association. In that review I say further:

Prodigious effort has been made by the human race to better its condition but this effort has been wholly in the direction of improving the environment. While Dr. Woods has shown that it is really an unimportant factor in determining natural impulses and native ability, it is true that when environment is unfavorable it may prevent the development of natural tendencies or may warp them, and it may also result in great

natural ability remaining practically useless for a lack of the implements which a full development of intellectual power would place in its hands. But improving the environment does not from generation to generation give better material for our schools to work on.

I have only one criticism of Dr. Woods's reasoning. In studying heredity in royalty he purposely chose this class because it could be assumed that their characters were formed under the most uniform environment, which purpose was of course entirely legitimate. But it must be remembered that this environment is the best possible for the development of character and ability. It would be gratifying to me to see Dr. Woods make a similar study of some class of human beings subjected to an unfavorable environment. I believe he would find, as I have stated above, that even in that class native ability and natural impulses would prove to be purely a matter of heredity; but that character and actual ability would be found to be profoundly modified by environment. In fact, the whole experience of the human race speaks for this assumption. If the opposite were true, then why should the state go to the expense of maintaining schools, for a man's effectiveness would not depend on his environment, but upon his inheritance.

I have a further criticism to offer of Dr. Woods's article in SCIENCE. In the first place, the men listed in "Who's Who in America" do not represent leaders, although they include leaders. Dr. Woods's own figures prove the effect of environment as against heredity. For instance: under the initial A he finds 29.6 per cent. of city born individuals instead of the 16.1 per cent. expected on the basis of population. This merely shows that of the men in "Who's Who in America," those who have had the best opportunities have done best. "Who's Who in America" lists those men who have done something of note. I am inclined to believe that fully half of these men owe their success to their opportunities. They are not leaders, though they are competent workers, and they are not the type of men I had in mind in my previous article.

Census statistics do not easily lend themselves to the determination of the proportion of our population who actually live on farms. In rural population they include cities of considerable size. It has been said that "God made man, man made the cities, and the Devil made the country village." I have no way of ascertaining how many of the men who are distinctly leaders in this country were actually brought up on the farm. I am inclined to believe that the conditions in country villages and small towns are less favorable for the development of character than those on the farm or those in great cities.

I have not had time to secure extensive statistics on the birth-place of men who have been and are leaders in the various lines of activity in this country. In my previous article I merely repeated a statement I have heard frequently, and which I had never heard challenged. From the best statistics I can secure, about 36 per cent. of our population actually live on the farm at the present time. Of the 25 presidents of the United States, 23 of them were country bred, or were brought up under what the census terms rural conditions, only our present president and his immediate predecessor having been brought up in the city, so far as a hasty glance at history and biography reveals. This is 92 per cent. of the total, and there is no question that these men have been leaders. Of the present membership of the United States senate, in so far as the congressional directory reveals the facts, 70.5 per cent. are country bred. The statistics for the house of representatives are not so conclusive. The fact that many congressional districts are wholly city districts while others are wholly country districts vitiate the statistics for that branch of congress, so far as our purpose is concerned.

I hope to be able, in the not distant future, to present other statistics bearing on this question. I believe, however, that when we consider the fact that our country schools have always been vastly inferior to our city schools, the few data given above show that there is something in farm life, during the first few years of the boy's training, that tends more nearly to give normal expression to his hereditary talents and impulses than do con-

ditions of city or village life. The matter must rest here until further statistics are available.

W. J. SPILLMAN

U. S. DEPARTMENT OF AGRICULTURE

THE RELATION OF THE METER AND THE YARD

TO THE EDITOR OF SCIENCE: It is a matter of astonishment to me that so many men, authors of scientific books, are ignorant of the fact that the relation between the meter and the yard is in the United States fixed by law, viz., 1 meter = 39.37 inches. In England the established relation is 1 meter = 39.370113 inches. As examples, see "Fortie's Electrical Engineers' Handbook," 5th Ed., 1908, p. 1500, and "Eggleston's Tables of Weights and Measures," 4th Ed., 1900, p. viii, in both of which the archaic, inherited necessary relation, 1 meter = 39.37079 inches is adopted. In trade catalogues an error of this sort is not so serious and is occasionally made; but in a scientific publication it is unpardonable.

MARSHALL D. EWELL

SCIENTIFIC BOOKS

Primitive Secret Societies. A Study in Early Politics and Religion. By HUTTON WEBSTER, Ph.D., Professor of Sociology and Anthropology in the University of Nebraska. New York, The Macmillan Co. 1908. Pp. xiii + 227.

This book, which has served in its original form as a thesis for the doctorate in political science at Harvard University, treats, in eleven chapters, of the men's house, the puberty institution, the secret rites, the training of the novice, the power of the elders, development of tribal societies, functions of tribal societies, decline of tribal societies, the clan ceremonies, magical fraternities, diffusion of initiation ceremonies. The author's studies were concluded before he became acquainted with the late Dr. Heinrich Schurtz's "Altersklassen und Männerbünde" (Berlin, 1902), of which, however, he was able to make some use in the present monograph. The book of Schurtz, rather *tendenziös* in places and somewhat marred by a philological appendix, but, nevertheless, an interesting and valuable summary of facts, was preceded by Boas's (1895–7) investigations of the social organization and secret societies of the Indian tribes of the North Pacific coast (particularly the Kwakiutl), which still remain the best source of information for that region, as yet not adequately used by any authority. For the Plains tribes we have recent investigations by Wissler, Dorsey, Fletcher, Kroeber, and for the Pueblos Indians, those of Fewkes, etc. The material in Dr. Webster's book, as is the case with all others dealing generally with the topic of secret societies and ceremonies, is preponderatingly Australasian, Indonesian and African, though at pages 15–19 ("men's house"), 131–134 (age-societies), 147–159 (clan-ceremonies) and 176–190 (magical fraternities), the aborigines of the new world receive particular attention.

The author begins with the "men's house," described as follows:

> The men's house is usually the largest building in a tribal settlement. It belongs in common to the villagers; it serves as council-chamber and town hall, as a guest-house for strangers, and as the sleeping resort of the men. Frequently seats in the house are assigned to elders and other leading individuals according to their dignity and importance. Here the more precious belongings of the community, such as trophies taken in war or in the chase, and religious emblems of various sorts, are preserved. Within its precincts, women and children, and men not fully initiated members of the tribe, seldom or never enter. When marriage and exclusive possession of a woman do not follow immediately upon initiation into the tribe, the institution of the men's house becomes an effective restraint upon the sexual proclivities of the unmarried youth. It then serves as a club-house for the bachelors, whose residence within it may be regarded as a perpetuation of that formal seclusion of the lads from women, which it is the purpose of the initiation ceremonies in the first place to accomplish. Such communal living on the part of the young men is a visible token of their separation from the narrow circle of the family, and of their introduction to the duties and responsibilities of tribal life. The existence of such an institution emphasizes the fact that a settled family life with a private abode is the privilege of the older men, who alone have marital rights over the women of the tribe. For promiscuity,

either before or after marriage, is the exception among primitive peoples, who attempt not only to regulate by complicated and rigorous marriage systems the sexual desires of those who are competent to marry, but actually to prevent any intercourse at all of those who are not fully initiated members of the community (p. 1).

As men's houses, or as survivals thereof are cited the *eramo* of New Guinea, the Dyak *pangah*, the Formosan *palangkan*, the Dravidian (Oraon) *dhumkuria*, the Naga *morang*, the Polynesian *marae*, the Bechuana *khotla*, the Unyamwezi *iwanza*, the Bororó (Brazil) *baito*, the Pueblo *kiva*, the Hupa *taikyuw*, the Eskimo *kashim*, etc., but the unitary origin and service of all these is by no means demonstrated. According to Dr. Webster, "the presence in a primitive community of the men's house in any one of its numerous forms points strongly to the existence, now, or in the past, of secret initiation ceremonies." With some tribes the men's house "is used as the center of the puberty initiation ceremonies," and, "with the development of secret societies, replacing the earlier tribal puberty institutions, the men's house frequently becomes the seat of these organizations and forms the secret 'lodge.'" The men's house thus "serves a general purpose as the center of the civil, religious and social life of the tribe, and a special purpose as the abode of unmarried males." The first secret society is thus a "clan," which excludes women and boys. Next comes, apparently, the "puberty institution" with other subdivisions based on age and the recognition of its value to the community. Here the elders are in control and secret rites for the initiation of young men, their subjection to ordeals, and instruction in tribal wisdom and obedience (often in long periods of seclusion) appear to be "the characteristically social feature of primitive life," and "these mysteries, as the most conservative of primitive customs, provide an effective means of social control." These initiation ceremonies are tribal and communal machinery organized and conducted by the elders which can no longer operate when obedience to the tribes is replaced by obedience to the chief, and "initiation ceremonies, such as have been studied, retain their democratic and tribal aspects only in societies which have not yet emerged from that primitive stage in which all social control is in the hands of the tribal elders" (p. 75). And, "with increasing social progress, the powers of control are gradually shifted from the elders to the chiefs, and tribal societies charged with important political and judicial functions arise on the basis of the original puberty organizations." The new order of things brings with it limited membership, "degrees," "lodges," elaborate paraphernalia of mystery, etc. Secret societies may now "represent the most primitive movement towards the establishment of law and order," or may "embody the inner religious life of the tribe" and gather strength "from the pretended association of their members with the spirits and ghosts of the dead." Tribal secret societies arising through "a process of gradual shrinkage of the original puberty institution, in which, after initiation, all men of the tribe are members," often survive as "organizations of priests and shamans, in whose charge are the various dramatic and magical rites of the tribe" (p. 135). In connection with his argument at this point Professor Webster holds that "among the northwest tribes (of American Indians) the clan organization is in decay and secret fraternities in initial stages of development," and "among the tribes of the southwest the totemic clans have broken down to be replaced by numerous and well-developed magical fraternities," both statements open to serious objections, as to fact and also as to theory. In the rites of these magical fraternities too many "survivals of primitive puberty rites" are seen by the author; and the diffusion of such rites is perhaps not so extensive as he believes. The list of tribes possessing no puberty rites and, consequently, none of the social paraphernalia held to be developed from them would be of interest here. It is quite evident that even in primitive society there is something more than sex. It would be worth while knowing, as a contrast to the "men's house," how widespread and how "primitive," *e. g.*, is the

maloca, a characteristic house of the Indians of northwestern Brazil, recently described by Dr. Koch-Grünberg.[1] The *maloca's* inhabitants are mostly one family, often an old couple with their grown-up sons and their families, etc. They number from 10 to 100 individuals, all under the same roof, and the author testifies to the good-behavior and morality of them all. Owing to the practise of extra-tribal marriage it frequently happens that women speaking absolutely distinct languages live in the same *maloca*. In it also are celebrated some of the great dance-festivals. The sick are cared for within its walls and the dead interred beneath the floor. The *maloca* is thus as far removed from the "men's house," as can well be imagined, and it exists among very primitive folk. This serves to illustrate the relativity of some of the ideas and institutions involved in the discussion of "primitive politics and religion." The esoteric element, though often notable and significant, has probably been overestimated in the history of human evolution.

In the opinion of the reviewer, the author will add to the value of his interesting book if, in a second edition, he makes an index and presents the bibliography in alphabetical order at the close and not as now in rather distracting though instructive footnotes.

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[1] "Das Haus bei den Indianern Nordwestbrasiliens," *Archiv für Anthropologie*, 1908, N. F., VII., 37–50.

Unsere Ahnenreihe. (Progonotaxis hominis.) Kritische Studien über phyletische Anthropologie. By ERNST HAECKEL. Jena, Gustav Fischer. 1908.

This quarto memoir of fifty-seven pages is, as its title-page indicates, a Festschrift in honor of the 350th anniversary of the Thuringian University at Jena, the celebration of which was made the occasion for the transference to the university of the "Phyletic Museum" founded by Professor Haeckel, "das erste Museum für Entwicklungslehre." The occasion was naturally propitious for a consideration of that most interesting of all phyletic problems, the descent of man, and in the memoir before us Professor Haeckel has traced the various steps, as he conceives them, through which the line of ascent has passed from the moners to man. What is presented is, however, almost entirely a repetition of the material to be found in chapters XIX.–XXIII. of the "Evolution of Man," a work that has already been noticed in these columns,[1] and it is not until toward the close of the memoir that any new contribution to the question is to be found. Here, after some notice of *Pithecanthropus* as the "missing link" and a paragraph devoted to *Homo primigenius*, under which term are included the Neander, Spy and Krapina men, one finds a description of the most striking peculiarities of a skull of an Australian aborigine from Queensland, which Professor Haeckel regards as "the most remarkable human skull of the many thousand with which anthropology has concerned itself." He considers it as representing a reversion to the ancestral *Homo primigenius*, and for this reason creates for its original possessor the species *Homo palinander* (= *Homo primigenius recens! -atavus?*).

Five plates, giving views of the norma frontalis, occipitalis, verticalis, basalis and lateralis of this skull, together with those of *Homo sapiens (germanus)*, *Anthropithecus niger*, *Hylobates mulleri* and *Cynocephalus mormon*, complete the memoir and are beautiful examples of photographic reproduction. A sixth plate, the series of mammalian embryos familiar to all readers of Haeckel's works, hardly requires comment.

It may be remarked, however, that the author's predilection for the coinage of new terms in order to give definiteness to his concepts, finds expression in the memoir, but hardly with as happy results as usual. For the terms *Homo neander*, *H. spyander* and *H. krapinander*, consistent as they are orthographically, are certainly most inconsistent etymologically.

J. P. McM.

[1] SCIENCE, N. S., Vol. XXII., 1905.

Introduction to the Rarer Elements. By PHILIP E. BROWNING, Ph.D., Assistant Professor of Chemistry, Yale University. Second edition, thoroughly revised. New York, John Wiley & Sons. 1908. Pp. x + 207, 2 plates.

The first edition of this book was reviewed in these columns in 1903.[1] After five years it has been revised, much new material being added. This is especially the case in regard to the radio-elements, the excellent chapter upon that topic being contributed by Professor Boltwood, a colleague of the author.

While the book is teeming with information, it does not pretend to be a compendium. However, one feels the lack of proportion when he observes that forty-nine double chlorides of cæsium (p. 11) are mentioned and only one oxide of rubidium is named. The statement is made (p. 63) that metallic præseodidymium and neodidymium have not been separated. Mpthmann accomplished this very cleverly several years ago and his method has been applied successfully in the reviewer's laboratory. Good crystals of metallic thorium have also been obtained by another method, namely, reduction by aluminium, published in the Year Book of the Carnegie Institution. It is not mentioned. A satisfactory method for separating zirconium and aluminium (p. 78) published fifteen years ago is not incorporated. Nor is the only good method for separating zirconium and titanium (by hydrogen dioxide) given. The chapter on the uses of the rarer elements is in much need of revision. The recent work on scandium is not included.

The colored plate of the spectra is a good illustration of the printer's art, but the small plate on the absorption spectra is poorly chosen, in fact, is incorrect. Additional plates would be helpful, as well as a general discussion of some of the principles involved in the fractionation of these "complexes of elemental matter," as Crookes put it. There is an index, but it is inadequate.

The book must have served a good purpose and every library of chemical works should have a copy, for the term "rare earth" does not frighten teacher or student quite as badly as formerly. This is due in large part to a book of such rightness of purpose as is this one.

CHAS. BASKERVILLE

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[1] SCIENCE, N. S., XVIII., 497.

SCIENTIFIC JOURNALS AND ARTICLES

The American Museum Journal for March contains the following articles: "The Darwin Celebration," with views of the bust of Darwin presented to the museum by the New York Academy of Sciences; "New Habitat Groups of North American Birds," six in all, with an illustration of each. These groups mark the highest point reached in presenting to the public an accurate idea of the bird life of various parts of our country; they have been made possible by the liberality of a number of friends of the museum and of the public. A notice of "The Annual Meeting of the Trustees" notes that the present endowment fund is $2,048,156, and that last year the museum expended $115,488, and the city $159,930. There is a letter from Mr. Stefansson, on "The Stefansson-Anderson Arctic Expedition," and an account of "Recent Purchases of Fossil Vertebrates."

The Museums Journal of Great Britain for February has an article on the "Victoria and Albert Museum," reviewing the recent report on its rearrangement, classification of its material, relations of the national museums to one another, and on the general policy of the institution. Most interesting is the account given by Rev. J. S. Whitewright of "Pioneer Museum Work in China." The models, diagrams and maps, many of them large and elaborate, were made on the spot by Chinese artisans. The number of visitors—there were 69,745 in thirty-six days—shows the success of the work. Robert Standen tells how to make and use "Glue and Turpentine Cement for Alcoholic Mounts." There are the customary reviews and notes.

SPECIAL ARTICLES

A LITTER OF HYBRID DOGS

SEVERAL years ago the writer had the opportunity of observing the results of a cross be-

tween two "thoroughbred" dogs. The breeds were sharply contrasted in many characters and the results were so striking that an effort has been made to collect the data regarding the offspring, from the owner of the dogs. While the data thus obtained are of course very incomplete, they are considered of sufficient interest to merit a brief record. Practically nothing of a scientific character appears to have been done in this very interesting field for students of heredity.

The mother of the cross in question was an Old English Bobtailed Sheep Dog and the father a Scotch Collie so-called. Both were typical specimens of their respective breeds. The dogs were accompanied by a guarantee

	Mother	Father	Pup No. 1	Pup No. 2	Pup No. 3	Pup No. 4	Pup No. 5	Pup No. 6
Color.	Grizzly throughout except white breast.	Black and tan, breast white, body jet-black, legs tan from feet to first joint.	Black, breast and paws white.	Blue-gray throughout, except white breast and paws.	Body black, legs light tan.	Body black, legs light tan.	Dark brown, except white breast.	Large patches of white and light yellow over whole body. Fore legs white, hind yellow.
Character of coat.	Long and shaggy over whole body, including eyes, face and legs.	Heavy and wavy.	Shaggy, hanging over eyes, face and legs (mother) but very wavy (father).	Shaggy, long, wavy hair over whole body, including eyes, face and legs.	Hair short and smooth.	Hair short and smooth.	Thick, wavy hair over whole body, including face and legs.	Hair short and smooth.
Tail.	None. No projecting bone.	Long and bushy, jet-black.	About four inches long.	About four inches long.	About eight inches long.	About eight inches long.	Six inches long with a kink in the middle.	Long and bushy, yellow.
Eyes.	Dark brown.	Light brown.	Dark brown.	Dark brown.	Light brown.	Light brown.	Dark brown.	One wall eye, one light brown.
Disposition.	Very gentle and timid.	Playful and aggressive.	Gentle and timid (mother) but at times inclined to snap (father).	Very gentle.	Very aggressive.	Gentle.	Aggressive.	Very timid.
Legs and body.	Body long, legs long. Hind legs very short from feet to hock, but very long from hock to hip.	Legs ordinary length and shape.	Like mother.	Like mother.	Like father.	Like father.	Like mother.	Like father, but smaller.
Shape of head.	....	....	Like mother.	Like mother.	Like father.	Like father.	Like mother.	Like father, but smaller.
Sex.	....	....	Male.	Male. Like No. 1, except in color.	Male.	Female. Just like No. 3 except disposition.	Male.	Female.

that they were thoroughbred, and were brought from England to Nova Scotia by an English gentleman for the purpose of crossing them to produce a dog for farm purposes.

I had occasion to observe both dogs carefully for a considerable period, and I also owned one of the pups for several years. The pups were born in June, 1894. I am, of course, aware of the dangers of collecting *post facto* data and have therefore included here only such facts as I can verify with certainty from my own recollection. The data given under "legs and body" and "shape of head" are of course only general impressions of a probably more or less blended condition.

The accompanying table shows some of the contrasting characters in the parents and the offspring. The most striking contrasts are afforded by the color and character of the coats, the presence and absence of the tail, and its variability in the offspring, and by the dispositions, that of the mother being very gentle and timid, while the father had the aggressive collie disposition. The litter contained more than six pups, but these are the only ones which can now be sharply and definitely characterized. It is a noteworthy fact that several of them are in pairs which are very closely alike, differing markedly in only one character so far as observed. Numbers 1 and 2 were alike except in color, one having the general color of the mother, and the other that of the father but without any tan. Numbers 3 and 4 constituted another very clearly marked pair, differing widely from the others in many characters and yet so closely alike that they were scarcely distinguishable, except in their dispositions, which were quite unlike. This recalls some cases of identical human twins. These animals were not of the same sex, however.

In comparing the characters of the offspring with those of the parents it will be seen that in no character was there complete dominance of one parent in all the offspring. In coat color the father dominated in all but two, in one of which (No. 2) the color was that of the mother. The long, shaggy coat, covering the face and legs as well as the body, appeared in Nos. 1 and 2 of the offspring, except that the effect of the wavy hair of the father was also more or less evident. In No. 5 the coat more nearly resembled the father, but in Nos. 3, 4 and 6 was quite unlike either parent, being short, smooth and sleek. The differences in eye color may not be significant, as the collies' eyes range from light to dark brown, and in the sheep dogs a wall eye is not uncommon and is considered typical of the breed.

The inheritance of the tail character is of considerable interest, showing as it does a range from the long bushy tail of the father to a condition approaching its complete absence as in the mother. The intermediate tail lengths can not be attributed wholly to inheritance from the father, however, for dogs with more or less of a tail are said to occur frequently in the pure sheep-dog breed. How the tailless condition originated appears to be unknown, although various statements and conjectures are made in dog books concerning this matter. Two breeds of bob-tailed collie, with tails 5–10 cm. long but otherwise in every particular like the collie, are recognized in certain parts of England[1] (II., p. 440). Walsh[2] says (p. 221):

> Until within the last half-century sheep dogs without tails were exempt from taxation, it being supposed that no one would keep a tailless dog who could afford to pay the tax. As a consequence almost every sheep dog had its tail cut off, and owing to this cause the tailless sheep dog, still met with in some localities, is supposed to have arisen. . . . It is far more probable that the bob [in pointers] is derived from a cross with the bull dog, which is subject to the natural loss of tail in a greater or less degree, and was probably used to give courage to the pointer. . . . Usually these "bobs" [the old English sheep dog] are strongly made and symmetrical dogs, but without any definite type; they have frequently a tendency to the brindle colour, which favours the theory of the derivation of short tails from the bull dog though it cuts equally against a similar derivation in the pointers, in whom the brindle is absolutely

[1] "Dogs of All Nations," 2 vols., London, 1905, illustrated.

[2] Walsh, J. H., "The Dogs of the British Islands, etc.," 5th edition, London, 1886, pp. 292, illustrated.

unknown. Not being able to arrive at any definite type of the "bob-tail," I shall not attempt to describe him.

From this writer it would appear that the Old English Bob-tail is a recent, or at least variable and poorly characterized breed. Lee[8] states, however, that Reingle's picture in the "Sportsman's Cabinet," very early in the last century, is typical of the breed as at present known, showing that this breed has probably existed for at least a century. He further states that it is possibly older than the collie. The varieties in England and Scotland are said to be identical, except that the latter usually has a long tail, the reason attributed for this being that the owners have steadfastly refused to amputate it! It is stated that in England many of these dogs are born either without tails or with very short ones, pups with and without tails usually occurring in the same litter. The tails may be docked so that no one can tell that the animals were not born tailless. They are said to be jet-black at first with white markings, in a few weeks becoming "silvery-lilac."

This writer argues that the antiquity and concentration of the strain is shown by the fact that if there is a strain of this breed in such breeds as the retriever, lurcher or spaniel many generations back, a typical specimen will occasionally appear.

In the "Dogs of All Nations" already referred to, which is a standard authority on the good and the bad points in the various breeds of dogs, giving their characterization according to the various dog clubs and breeders, a black and tan or brindle coat is considered a fault in the Old English Bobtail breed (*l. c.*, II., p. 471).

Such remarkable diversity as here described in a single litter of offspring could not be accounted for by the effect of external conditions of development and must therefore be due to differences of some sort in the germ cells of either or both parental individuals. No one character is present in all the offspring to the exclusion of its homologue. There is a decided tendency in any given character for the offspring to "take after" one parent or the other, though in certain cases, as in the character of the hair in Nos. 3 and 4, there is a marked departure from either parent. This is perhaps the reappearance of a character derived from some cross in the ancestry of one of the breeds.

One further fact worthy of mention is the disposition of dog No. 1. I had him in my possession for several years and often observed the usually very subdued and timid behavior, and at times the sudden and unexpected change to the aggressive attitude of his father. It will be noted that some of the dogs inherited the aggressive disposition of their father and others the timid and gentle disposition of their mother.

R. R. GATES

UNIVERSITY OF CHICAGO,
April 2, 1909

[8] Lee, Rawdon B., "A History and Description of the Modern Dogs of Great Britain and Ireland (Non-sporting Division), etc.," London, 1899, pp. 428.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
SECTION E—GEOLOGY AND GEOGRAPHY

SECTION E, Geology and Geography, of the American Association for the Advancement of Science, met Monday morning, December 28, 1908, at Johns Hopkins University. The section organized at 11 A.M., immediately after the adjournment of the general meeting of the association. The first five papers of a Symposium on Correlation were given during the morning and afternoon sessions on Monday. This symposium was continued on Tuesday and Wednesday under the auspices of the Geological Society of America.

Professor J. P. Iddings, of Chicago, gave his vice-presidential address, "The Study of Igneous Rock," on Monday, at 2:30 P.M.[1]

According to the custom for several years past, Section E adjourned Monday P.M., but its fellows and members were cordially invited to be present at the sessions of the Geological Society of America, December 29 to 31, 1908, and at those of the Association of American Geographers, January 1 and 2, 1909.

Following the dinner of the Geological Society of America on Wednesday evening there was a discussion of the relations that should obtain

[1] SCIENCE, Vol. XXIX., pp. 202-217.

between Section E and the Geological Society of America and the Association of American Geographers. This was done in order that the officers of the three geologic-geographic organizations may be able to plan future meetings for the reading of papers and for field excursions, so that the needs and wishes of all geologists and geographers may be met as fully as possible.

On Thursday evening, December 31, Dr. Albrecht Penck, professor of geography at Berlin University and Kaiser Wilhelm professor at Columbia University, delivered a public address on "Man, Climate and Soil," given under the auspices of the Association of American Geographers.

The Society of Vertebrate Paleontologists held its meeting during the week, an account of which has been given in SCIENCE.[3]

SYMPOSIUM ON CORRELATION

Monday, December 28

Pre-Cambrian.

C. R. Van Hise, "Principles of pre-Cambrian Correlation."

F. D. Adams, "The Basis of pre-Cambrian Correlation."

Discussion.

Early and Middle Paleozoic.

C. D. Walcott, "Evolution of Early Paleozoic Faunas in Relation to Their Environment."

Discussion.

A. W. Grabau, "Physical and Faunal Evolution of North America in the Late Ordovicic, Siluric and Devonic Time."

Discussion.

Stuart Weller, "Correlation of Middle and Upper Devonian and Mississippian Faunas of North America."

Discussion.

Tuesday, December 29

Late Paleozoic.

G. H. Girty, "Physical and Faunal Changes of Pennsylvanian and Permian in North America."

David White, "The Upper Paleozoic Floras, Their Succession and Range."

Discussion.

Vertebrates.

S. W. Williston, "Environmental Relations of the Early Vertebrates."

H. F. Osborn, "Environment and Relations of the Tertiary Mammalia."

Discussion.

[3] Vol. XXIX., pp. 194–198 and 376.

Mesozoic and Tertiary.

T. W. Stanton, "Succession and Distribution of Later Mesozoic Invertebrate Faunas."

Discussion.

W. H. Dall, "Conditions Governing the Evolution and Distribution of Tertiary Faunas."

Ralph Arnold, "Environment of the Tertiary Faunas of the Pacific Coast."

Discussion.

Wednesday, December 30

Tertiary and Quaternary.

F. H. Knowlton, "Succession and Range of Mesozoic and Tertiary Floras."

Discussion.

R. D. Salisbury, "Physical Geography of the Pleistocene with Special Reference to Conditions Bearing on Correlation."

D. T. MacDougal, "Origination of Self-generating Matter, and the Influence of Aridity on its Evolutionary Development."

Discussion.

T. C. Chamberlin, "Diastrophism as the Ultimate Basis of Correlation."

The following note on the symposium on correlation, was prepared by Mr. Willis, for the secretary's report of the Baltimore meeting:

In accordance with the announcement made in SCIENCE, December 18, 1908, a symposium on correlation was presented at the Baltimore meeting under the auspices of Section E and the Geological Society of America. The object proposed was a discussion of the physical and biological criteria of correlation, and the influences of the physical upon the biological. While most of the papers presented were mainly paleontological, there was generally throughout the papers and the discussions an undercurrent of thought with reference to this relation of cause to effect. In some cases decided emphasis was placed upon the relation of faunas and floras to environment.

Messrs. Van Hise and Adams presented two views concerning the criteria of correlation of the pre-Cambrian and the classifications which result from their application. Van Hise maintained the validity of the dual classification of the pre-Cambrian, and, after discussing the value of lithologic similarity, stratigraphic similarity and unconformities for matching strata, applied these methods to the North American pre-Cambrian with results which he has elsewhere published recently. Adams approached the problem as a part of the record of continental history and based a tentative classification of the pre-Cambrian upon possible parallel events in North

America and Eurasia. In discussion Van Hise pointed out the similarities between the two sets of conclusions.

The correlation of the major part of the Paleozoic was discussed by Messrs. Walcott, Grabau and Weller, whose papers comprised the period from Cambrian to Mississippian, inclusive. Walcott followed conservatively the lines of classification laid down in his earlier papers on the Cambrian of North America. He felt obliged by the state of investigations to confine his discussion largely to evidence afforded by the brachiopods and indicated that more elaborate conclusions might be suggested by a similar thorough study of the trilobites and other elements of the faunas. Grabau discussed the faunas and sediments of Ordovician, Silurian and early Devonian times, together with certain phases of the paleogeography and climatic conditions, especially of New York and Michigan. Weller stated that during Middle and Upper Devonian time the faunas of North America occupied three provinces, the eastern continental, interior continental and the western continental. The provincial conditions continued into early Mississippian time, but gave place to more cosmopolitan conditions through the development of the great Mississippian province, with sub-provinces east of the Cincinnati arch and also in the western part of the continent.

The late Paleozoic and early Mesozoic were discussed by Messrs. Girty, David White and Williston, with reference, respectively, to the invertebrate faunas, the floras and the vertebrates. Girty considered chiefly the relations of the Pennsylvanian and possible Permian faunas of North America, and their correlation with the Permian of Russia. White brought out the world-wide distribution of certain late Paleozoic floras and touched upon the paleogeographic relations essential to their distribution.

Williston was followed by Osborn, who discussed the Cenozoic vertebrates, and in the discussion of their two papers the value of vertebrate paleontology in its bearing upon former land connections was distinctly apparent.

In discussing the succession and distribution of the later Mesozoic invertebrates, Stanton considered late Jurassic, Lower Cretaceous and Upper Cretaceous faunas in their bearing upon the geography of those periods. A problem of peculiar difficulty is presented by the marked distinction which exists between the Lower Cretaceous fauna of the gulf region and that of the Pacific coast, in spite of the fact that in Mexico a Pacific fauna invades the western margin of the province that was usually occupied by the gulf fauna. In order to explain these relations it appears to be necessary to recognize the probable existence of a southern extension of the land area of Arizona and its partial submergence first from the east and then from the west.

In discussing the conditions governing the distribution and evolution of Tertiary faunas, Dall emphasized the importance of temperature of marine waters and showed that in so far at least as Tertiary and existing faunas are concerned, it formed the dominant condition limiting the migration or continuance of the fauna. Following Dall in the discussion of Tertiary faunas, Arnold gave a detailed analysis of the Tertiary of the Pacific coast, and exhibited maps showing the geographic conditions at various stages from Eocene to Pliocene.

Closing the consideration of the historic succession, Knowlton discussed Mesozoic and Tertiary floras, Salisbury brought out those phases of physical geography of the Pleistocene which had special relations to conditions bearing on correlation, and MacDougal presented a consideration of the origination of self-creating matter and the influence of aridity upon its evolutionary development.

The symposium was closed by Chamberlin, who discussed diastrophism as the ultimate basis of correlation. The speaker emphasized the view that diastrophism is the basal phenomenon according to which other phenomena that afford criteria for correlation are modified and developed. Taking a broad view of the whole subject, he held that the periodicity of diastrophic movements affords the criteria for determining the major divisions, but he recognized also that all the related lines of evidence are required to work out the minutiæ of the problems of geologic correlation.

In connection with the discussions paleogeographic maps of North America at fifteen different periods were exhibited. They represented studies by Willis in association with a number of colleagues in regard to the geologic provinces of North America.

The arrangements for the symposium on correlation included one unusual feature, inasmuch as a definite time schedule was prepared and published in the program, and this schedule was strictly adhered to during three days' proceedings. In general, about three quarters of an

hour was allowed for the presentation and discussion of each topic; the principal speaker took thirty minutes or less; the remainder of the time was given to discussion of the subject as presented by him. The following speaker was not allowed to begin until the hour stated on the program had arrived. This plan appeared to work to the satisfaction of the audience; the speakers confined themselves practically to the time allotted, and their convenience and that of all who had an interest in the subject was satisfactorily served.

The papers contributed to the symposium will appear in the *Journal of Geology* of Chicago University, in chronological order.

Monday morning at 11 A.M. in a subsection, with G. K. Gilbert as chairman, the following papers were read:

Some New or Little-known Geological Terms and their Application in Stratigraphic Writing: A. W. GRABAU.

The following terms were discussed and defined:

1. *Disconformity*, proposed by Grabau in 1905 to cover unconformable relation of strata where no discordance of dip exists, the term *unconformity* being restricted to cases with perceptible discordance of dip.

2. *Rudaceous* and *rudyte*, *arenaceous* and *arenyte*, *lutaceous* and *lutyte*, proposed by Grabau in 1904 for pebbly, sand and mud rocks, respectively, irrespective of their composition; classification of clastic rocks by texture being advocated. According to composition we may have: *silicirudytes*, *silicarenytes*, *silicilutytes; calcirudytes*, *calcarenytes*, *calcilutytes; argillutytes*, etc.

3. *Chronofauna* and *chronoflora* and *locofauna* and *locoflora* (new), the first two for fauna and flora of a given time period, the other two for the fauna and flora of a locality.

4. *Epiplankton* (new) for organisms attached to floating objects and not primarily planktonic. There have been included under this term *pseudoplankton*, which it is proposed to restrict to dead organic and to inorganic planktonic matter.

5. *Epicontinental sea* to be restricted to the shallow seas lying within the continents and constituting with the *mediterraneans* the *intracontinental seas*. The term littoral to be applied as in zoology to the district extending from high water to limit of sun-illuminated bottom (edge of continental shelf in the oceans) and characteristic of oceans, intracontinental seas and lakes. The term epicontinental sea is not to be applied to the littoral district of the oceans as thus defined.

6. *Migration* to be active—in search of food, escape from enemies, etc.; *dispersal* to be passive—by currents, water or air, etc., or by carriage by other organisms, etc.

This paper was discussed by G. K. Gilbert.

Some Preglacial Valleys in Eastern New York and Their Relation to Existing Drainage: JOHN H. COOK.

The valley of the Mohawk from Schenectady to the Hudson River is of post-glacial origin, as shown by the fact that between Niskayuna and Fort's Ferry it crosses a filled channel, trending north-northeast towards Round Lake and south towards Albany (at which city this channel probably opens into the Hudson valley).

For two miles above Schenectady borings along the Mohawk developed no rock at a depth considerably below the rock bottom of the river at the entrance to the upper gorge near Rexford Flats.

The channel of the preglacial Mohawk lies beneath the sediments of glacial Lake Albany, but may be traced approximately. It parallels, roughly, the Helderberg escarpment and probably reaches the Hudson just north of Coeyman, where there is a break in the rock wall elsewhere almost continuously exposed for several miles north and south of that point.

Drift and sands and clays deposited during the retreat of the ice sheet had filled these channels and spread widely over the divides when the reexcavation of the Hudson valley and the draining of Lake Albany were accomplished. The waters of Lake Iroquois still found outlet through the Mohawk valley as far as Schenectady, but, as a point near Rexford Flats lay at an elevation below the level of the deposits immediately south and west, the stream there poured over the low divide, crossed the filled channel mentioned above and took the course it now pursues to the Hudson.

This paper was discussed by G. K. Gilbert and F. P. Gulliver.

Monday afternoon, following the vice-presidential address of J. P. Iddings on "The Study of Igneous Rocks," the reading of papers was continued.

The Metamorphism of Glacial Deposits: FRANK CARNEY.

Till and tillite are two extremes in the structure of glacial deposits.

So far as we yet know, the periods of glaciation are spaced by long lapses of time; therefore we have only disconnected data in the metamorphic cycle of glacial sediments.

Evidence is adduced tending to show: (1) That some chemical activities are accentuated by the saturated condition of sediments beneath an ice-sheet. Carbonation and hydration would be enhanced, and even oxidation may occur. (2) That the great pressure to which unconsolidated materials of an earlier drift sheet are subjected by a later invasion of ice is an important agent of alteration. This pressure based on a conservative estimate of the thickness of the ice amounts to over nine thousand pounds per square inch. Not only are these materials made compact, but they are faulted and jointed. Furthermore, this density increased capillarity which has operated in more recent alterations. In addition to the pressure of a superincumbent ice-mass, it is probable that hydration has increased the pressure-effects.

This paper was discussed by George D. Hubbard.

A New Occurrence of Carnotite: EDGAR T. WHERRY.

A supposed occurrence of autunite at Mauch Chunk, Pa., has been investigated, and the material found to be similar in character to the Colorado carnotite. It occurs in layers of conglomerate at the top of the Mauch Chunk red shale on the west side of the Lehigh River, one mile north of the town, having been extracted from intercalated lenses of black shale and graywacke and deposited in fissures and porous beds by circulating surface waters. The dark color of these lenses is due, not to carbon, but to the presence of comparatively fresh hornblende, biotite, etc., resulting from the disintegration of the metamorphic rocks of the highlands to the south and east, during the arid climate prevailing in late Mississippian times, and much of the vanadium and uranium originally distributed through these sediments concentrated in them. As the western deposits of carnotite occur in similar positions, namely, in arenaceous formations overlying red shales, it is suggested that they may have had a similar origin.

The Phenomena of Æolian Sand Drift: E. E. FREE.

Wind-drifted sand moves by "saltation" or in a series of leaps in a manner quite analogous to that recently described by McGee for the suspended matter of streams. The forms shown by collections of such sand are of two main types: (1) the large heaps or dunes, (2) the minor surface figures, of which ripples form the best example. Previous discussions of dune formation are satisfactory except that far too little importance has been assigned to the eddy behind the dune. Many anomalous forms can be explained as due to it. Ripple formation is probably connected with the production in the moving air of eddy systems analogous to the Helmholtz vortex-surface.

This paper was discussed by C. H. Richardson, George D. Hubbard, J. H. Cook, G. K. Gilbert and F. P. Gulliver.

The following papers were read by title.

The Mills Moraine, with Some General Remarks on the Glaciation of the Longs Peak Region of Colorado: EDWARD ORTON, JR.

The Longs Peak group is a mountain mass with several summits, lying in front or east of the continental divide and connected with it by one narrow and much-dissected ridge or spur. The district is very wild and rough and existing maps are of the most elementary sort and furnish no accurate details. The highest peak is 14,271 feet high and the mass as a whole, towering 1,000 or 1,500 feet above the general summit level of the main range of the Rockies, is easily the dominating point of northern Colorado.

Separating the main range and the Longs Peak group are deep gorges occupied by the head waters of the Big Thompson and the St. Vrain rivers. The heads of these gorges, winding around behind Longs Peak, cut deeply into the connecting ridge, and have nearly isolated the group from the main range, of which it was once an integral part.

The high valleys and cirques lying between the main range and the western slopes of the Longs Peak mass, offered an excellent gathering ground for snows, owing to the great elevation of the peak and the position of the gorges with reference to the prevailing winds and storms. Great glaciers developed there, and made their way out north and south, curling around to the eastward past the base of the great peak on either side, and building magnificent moraines along their flanks and termini. The nature, location and general topographic features of these moraines is discussed, and some evidences of periodicity in their development is noted.

On the east side of the Longs Peak group, located in a small cirque between the three highest summits, a small but very active glacier has been at work, and has built up a very beautiful moraine system, entirely independent of the general glaciation of the district. On account of this isolation, these moraines offer a very good opportunity for a study of the periodicity of the glacial phenomena of the mountain areas of the west.

A topographic map drawn from original surveys of the gorge of this, the Mills glacier, and the moraines which it built, has been prepared.

The Red Beds of the Wichita-Brazos Region of North Texas:[8] C. H. GORDON.

The region to which this paper relates is of special interest as having furnished the data for the discussions on the Texas Permian which have appeared in various publications in recent years. In the study of the underground water conditions of the region under the auspices of the U. S. Geological Survey, it was observed that the red sandy shales and red sandstones so conspicuous in the Wichita valley region were replaced southward in large part by blue shales, light-colored sandstones and limestones. In some places the transition from a sandstone into a limestone was plainly seen. Formations to which the names Wichita and Clear Fork have been given, when traced along their strike toward the southwest, are found to grade into those included under the terms Cisco and Albany. The former have been regarded as Permian, while the latter have usually been assigned to the Pennsylvanian. Some authors, however, have suggested that the Albany should be considered Permo-Carboniferous. An abundant marine fauna characterizes the beds toward the south. In the Red Bed region marine forms are few, appearing only in the few beds of limestone that persist. Along with them in this region appear vertebrate remains upon which the references to the Permian have been based. It is the conclusion of the author that the Red Beds of this region are the near-shore representatives of the Albany and the decision as to their age will rest upon that of the latter.

The Invertebrate Faunas and Correlation of Some So-called Permian Rocks of the Mississippi Valley, with Remarks on Their Stratigraphy: J. W. BEEDE.

Discussion of the stratigraphy, fossils and correlation of the higher Paleozoic rocks of Kansas and Nebraska and their correlation with rocks of the United States and Eurasia. Remarks on stratigraphy and paleophysiographic conditions under which faunas lived, and a few fundamentals of paleontologic correlation.

Differential Effects of Eolian Erosion upon Rock-belts of Varying Induration: CHARLES R. KEYES.

The desert regions of our country may be regarded as comprising those tracts where the annual amount of rainfall is less than ten inches. More than nine tenths of whatever rainfall there is sinks at once into the dry and thirsty soil and does not appear as stream-water at all. The only perennial rivers are those whose headwaters are extralimital and whose courses merely traverse the arid region on the way to the sea. With so small and unimportant precipitation characteristic of the arid country, the high evaporation, often several times greater than the amount of annual rainfall, and the loose dry soils, wind-scour becomes a far more potent erosive agency than is usually fancied.

The sequence of geologic terranes and their lithologic characters in the desert region, and particularly in the northern part of the Mexican tableland where the isle-like aspects of the mountain ranges dotting a vast sea of earth is so characteristic of what the Germans in the South African deserts have so aptly termed the "Inselberglandschaft," are such as to permit eolian influences to fashion their finest subjects of desiccate sculpture. Ten thousand feet of hard limestones are succeeded by an even greater thickness of soft shales and friable sandstones. On account of frequent and profound faulting which, in early Tertiary times, the region had undergone and the subsequent planing off of the country to the condition of a peneplain, there has been imparted to the areal distribution of the geologic formations a remarkable alternation of belts of resistant and weak rocks.

General desert-leveling and lowering of an elevated country by deflation is comparable in the nature of its larger relief effects to that of general corrasion in a humid climate. It is in the arid region that the eolian influences as erosional processes find their maximum activities. In the dry lands the weaker rock-masses are rapidly removed; while the harder belts long resist deflative attack. Under conditions of aridity, the differential effects of wind-scour, or deflation, upon rock-belts of contrasted induration are very different from what they are in a normal moist climate. The inequalities of surface relief are in consequence very much more intensified than when stream-action is the chief eroding agent. In general, it may be estimated that in the case of hard rock-masses in an arid land deflative erosion is probably less than one tenth as efficient as in a normal wet country water-action would be; while in the case of weak rocks it is more than ten times greater. This is, no doubt, one of the principal reasons why to most observers in the desert regions such manifest evidences of enormous ero-

[8] Published by permission of the director of the United States Geological Survey.

sion are so impressive on every hand, while the recognized absence of an abundance of running waters makes it appear that the progress of erosion must be extremely slow.

In southwestern United States, where the lofty and numerous desert ranges have been regarded as having developed out of an old peneplain, a remnantal portion of which seems to be represented in the great Mesa de Maya, where through faulting and folding there has been produced a rapid succession of resistant and weak rock-belts, where deflative phenomena are thought to be typically expressed, and where there are several large rivers flowing from the humid zones of the higher Rockies in deep canyons through to the sea, there appears to be all of the data at hand by which to measure not only the relative rapidity of deflation upon contiguous areas of hard and soft rocks, but also to gauge the comparative effects between erosion by direct deflation and erosion by corrasion unaided by extended chemical decomposition of the rocks at the surface.

Locus of Maximum Lateral Deflation in Desert Ranges: CHARLES R. KEYES.

Deflative erosion in an arid land is preeminently plains-forming. Its general effects are best likened to the work of the sea along an exposed coast where there is carved out of the shore a marine platform. In a smaller way, as a detritus-laden stream impinges against its banks, forming high bluffs or cliffs, so in the dry regions the swiftly moving air-current heavily charged near the ground with sands and dusts tends to wear away fastest the least sheltered portions of the desert hills and mountains.

The air-currents of the desert are both strong and constant. Their transportative powers have never been measured quantitatively. When transportation is active the "sandstorm" results. The personal discomfort to the traveler in a sandstorm is so very great that he is usually oblivious to all else. The volume of soil flowing along the surface of the ground during one of these storms must be prodigious. Compared with the amount of sediments carried along by some large river, as the Mississippi in time of flood, it is estimated that in the lower twenty feet of the deflation-stream there are equal amounts of rock-waste moving in like cross-sections of the great river and of the air-stream of the desert. The air-stream moves forty miles an hour instead of four, as in the case of the water-stream; and in place of being only a mile wide the path of the sandstorm is several hundreds of miles in width. The lower six inches of the air-stream is almost wholly moving sand and fine gravel. The finer dust soars upwards thousands of feet, darkening the light of the sun as by a heavy thunder-cloud.

Over surfaces of drifted sands and of weak rocks the erosion is mainly accomplished by a trituration of the particles of the heavily sand-laden bottom stratum of moving air. Whenever bare or hard rock-masses are encountered there is vigorous sand-blast action. Thus, hypsometrically, among the desert ranges which are all composed of very hard rocks usually devoid of a soil-mantle, the notably exposed zone is at the very base of the mountains, or immediately above the surface level of the surrounding plains. This is probably the chief reason why there are no foothills flanking the mountain ranges of the desert, why mountain and plain so sharply meet, and why the bases of the desert ranges are often so abrupt and straight as to suggest at once the presence of fault-scarps as an explanation of the steep faces to the mountains.

When we institute search for direct evidences of fault-lines which are supposed to give rise to the escarpments, we usually look in vain. Although the mountain may be a faulted block the movement, however profound, is commonly discovered to be of ancient date. Its fault-plane is found to be far out in the plain, often at distances of four or five miles. The intervening space has a smooth and gently sloping rock-floor and has every appearance of a marine plain of denudation from which the sea has but recently retired. McGee[8] notes many such plains with extensive rock-floors fashioned from the hardest rocks, among the desert ranges of Sonora in Mexico. Others are described more in detail in the New Mexican region.[9] They are now widely known throughout the arid lands of the west. Thus, in the general leveling and lowering of the desert region anciently faulted and planed off so as to present alternating belts of resistant and weak rocks the areas of the latter are worn chiefly downward by the wind-action, but the hard mountain belts which have emerged from the softer areas are attacked laterally; and the zone of maximum eolation is at and just above the general plains-level.

A New Trachodon from the Laramie Beds of Converse County, Wyo.: CHARLES H. STERNBERG.

A complete skeleton, except hind feet, one tibia and fibulæ and tail vertebræ. It lies on its back

[8] *Bull. Geol. Soc. America*, VIII., p. 87, 1897.

[9] *Ibid.*, XIX., p. 78, 1908.

and the soft cross-bedded sand contains the impression of the skin that entirely envelops the bones, which are nearly all in normal position. The contents of the stomach are also preserved. It will be mounted as in death by the American Museum of Natural History.

Isobases of Post-Algonquin Elevation Across Lakes Michigan and Huron: J. W. GOLDTHWAIT.

The results of precise measurements of altitude of the Algonquin beach, during the last four years, are here summarized.

With data collected last summer for the Canadian Geological Survey, isobases of the deformed water-plane are constructed over the region east of Lake Huron and Georgian Bay in Ontario. It is found that at the south end of Lake Huron the Algonquin beach is horizontal, and twenty-five feet above the present lake; that forty or fifty miles north of Sarnia the beach begins to rise towards the north-northeast, at a rate which increases slowly to three feet per mile over Lake Simcoe, and then very rapidly north of Orillia to five feet per mile near the pre-Cambrian border. Beyond that, to North Bay, the warping seems to have been much more irregular.

The attitude of the deformed Algonquin plane, south of the pre-Cambrian boundary in Ontario, is compared with that over the north half of Lake Michigan, three hundred miles away. Isobases drawn across Lakes Michigan and Huron emphasize the close correspondence in the details of post-Algonquin uplifts in these two regions.

Conclusions are drawn as to: (1) The regularity of the uplifts over the Great Lake region, south of the pre-Cambrian border; (2) the southern limit of the uplifts; (3) the original altitude of Lake Algonquin above sea level and (4) the cause of the uplifts.

Sand and Gravel Resources of Nebraska: G. E. CONDRA.

This paper is now in press. It consists of 210 pages of text and 82 figures in Part 3 of Vol. 3, Nebraska Geological Survey.

The Glacial Character of the Yosemite Valley: F. E. MATTHES.

The Yosemite is a stream-worn canyon modified by ice erosion. That it is primarily a product of stream cutting no one familiar with its relations to the rest of the Merced River canyon, and with the position which the latter occupies in the series of great transverse valleys of the Sierra Nevada, will question. That it has been invaded by glaciers, on the other hand, and has to some extent been remodeled by them, is amply attested by the threefold record of glaciation, viz., the moraines, striæ and glacial sculpture in and about the valley. The glacial character of the Yosemite is however by no means equally pronounced throughout: most accentuated at the upper end, it rapidly fades downvalleyward and ultimately vanishes at the lower end. This gradation is explained by the circumstance that the valley lay close to the periphery of the glaciated zone of the Sierra. In earlier glacial times the ice advanced considerably beyond the foot of the valley, but the later glaciations appear to have been more moderate, the ice front seldom reaching down to the "gateway." The lower portion of the valley bears therefore no fresh signs of glaciation, and since the older icework has been considerably obliterated by subaerial erosion, its glacial character can now scarcely be detected except by the trained eye. The upper half of the valley, Tenaya Canyon and the Little Yosemite, on the other hand, having suffered more frequent, more intense and also more recent glaciation, have been extensively remodeled and present today a glacial aspect of the most pronounced and clear cut type.

The disparity between the lower and upper portions of the Yosemite is further heightened by the presence in the latter of a variety of aberrant sculptural features. The ice had to deal here with rock-masses of singularly variegated structure, ranging all the way from the schistose to the massive. Since ice accomplishes most of its work by plucking, its effectiveness as a sculpturing agent is largely determined by the fissility of the materials it attacks. Its action in the Yosemite was therefore necessarily a selective one, guided and controlled locally by the direction, attitude and distribution of the joints. Thus it was permitted to achieve large results where the intensity of the fissuring favored plucking, as in the region about the Cathedral Spires, while it found itself almost powerless against such huge masses of unjointed rock as Mt. Broderick, El Capitan, or the Cathedral Rocks. Again, the remarkable wall-like smoothness as well as the orientation of the cliffs over which the waterfalls plunge, reflects the strong directive influence of the joint structure.

LIST OF PAPERS READ BEFORE THE GEOLOGICAL SOCIETY OF AMERICA

Abstracts of these papers have been sent to SCIENCE by the secretary of the Geological Society of America.

President Calvin's address, "The Latest Phase of the Pleistocene Problem in Iowa."

Physical and Structural

Some Distinctions between Marine and Terrestrial Conglomerates: JOSEPH BARRELL.

The Chemistry of the Pre-Cambrian Rivers: REGINALD A. DALY.

The Primary Origin of the Foliated Structure of the Laurentian Gneisses: FRANK D. ADAMS and ALFRED E. BARLOW.

Relations of Present Profiles and Geologic Structure in the Desert Ranges: CHARLES R. KEYES.

Deflation and the Relative Efficiencies of Erosive Processes under Conditions of Aridity: CHARLES R. KEYES.

Unconformity Separating the Coal-bearing Rocks in the Raton Field, New Mexico: WILLIS THOMAS LEE.

Evidence that the Appalachian and Central Coal Fields were once Connected across Central Kentucky: ARTHUR M. MILLER.

The Bearing of the Tertiary Mountain Belt upon the Origin of the Earth's Plan: FRANK BURSLEY TAYLOR.

On Faults: HARRY FIELDING REID.

Mass Movements in Tectonic Earthquakes: HARRY FIELDING REID.

The Alaskan Earthquake of 1899: LAWRENCE MARTIN.

A Recent Landslide in a Shale Bank near Cleveland accompanied by Buckling: FRANK R. VAN HORN.

The Volcano Kilauea: C. H. HITCHCOCK.

Mt. Pelé of Martinique and the Soufrière of St. Vincent in May and June, 1908: EDMUND OTIS HOVEY.

Glacial

Multiple Glaciation in New York: H. L. FAIRCHILD.

Glacial Waters West and South of the Adirondacks: H. L. FAIRCHILD.

Correlation of the Hudson and the Ontarian Glacier Lobes: H. L. FAIRCHILD.

Pleistocene Features in Northern New York: H. L. FAIRCHILD.

Pleistocene Geology of the Southwestern Slope of the Adirondacks: W. J. MILLER.

Weathering and Erosion as Time Measures: FRANK LEVERETT.

The Glacial Phenomena of Southeastern Wisconsin: WM. C. ALDEN.

Concerning Certain Criteria for Discrimination of the Age of Glacial Drift Sheets as Modified by Topographic Situation and Drainage Relations: WM. C. ALDEN.

Lake Ojibwa, the Last of the Great Glacial Lakes: A. P. COLEMAN.

Glacial Erosion on Kelley's Island, Ohio: FRANK CARNEY.

Interglacial Epochs: ALBRECHT PENCK.

Stratigraphic

The Chalk Formations of Northeast Texas: C. H. GORDON.

Geologic History of the Ouachita Region: E. O. ULRICH.

Some Results of an Investigation of the Coastal Plain Formations of the Area between Massachusetts and North Carolina: WM. BULLOCK CLARK.

The Geologic Relations of the Cretaceous Floras of Virginia and North Carolina: EDWARD W. BERRY.

Occurrence of the Magothy Formation on the Atlantic Islands: ARTHUR BARNEVELD BIBBINS.

Erosion Intervals in the Tertiary of North Carolina and Virginia and Their Bearing upon the Distribution of the Formations: BENJAMIN L. MILLER.

The Character and Structural Relations of the Limestones of the Piedmont in Maryland and Virginia: EDWARD B. MATHEWS and J. S. GRASTY.

Recurrence of the Tropidoleptus Fauna and the Geographic Range of Certain Species in the Chemung of Maryland: CHARLES K. SWARTZ.

The Geological Distribution of the Mesozoic and Cenozoic Echinodermata of the United States: WM. BULLOCK CLARK and M. W. TWITCHELL.

On the Age of the Gaspé Sandstone: HENRY S. WILLIAMS.

Revision of the Paleozoic Systems in North America: E. O. ULRICH.

The Aftonian Sands and Gravels in Western Iowa: B. SHIMEK.

An Aftonian Mammalian Fauna: S. CALVIN.

The Brachiopod of the Richmond Group: A. F. FOERSTE.

Areal

The Trap Sheets of the Lake Nipigon Basin: ALFRED W. G. WILSON.

Reconnaissance in Arizona and Western New Mexico along the Santa Fé Railroad: N. H. DARTON.

Geologic Studies in the Alaska Peninsula: WALLACE W. ATWOOD.

Our Present Knowledge of the Oklahoma Red Beds: C. N. GOULD.

Paleontologic

The Fauna of the Glen Park Formation: Stuart Weller.

Petrologic

Some Features of the Wisconsin Middle Devonic: H. F. Cleland.

A Classification of Crystals based upon Seven Fundamental Types of Symmetry: Charles K. Swartz.

Quartz as a Geologic Thermometer: Fred. E. Wright and E. S. Larsen.

The Use of "Ophitic" and Related Terms in Petrography: Alexander N. Winchell.

Ice-borne Bowlder Deposits in mid-Carboniferous Marine Shales: Joseph A. Taff.

Chemical Composition as a Criterion in Identifying Metamorphosed Sediments: Edson S. Bastin.

Petrography of the South Carolina Granites (Quartz Monzonites): T. L. Watson.

Physiographic

Tertiary Drainage Problems of Eastern North America: Amadeus W. Grabau.

Pre-Glacial Drainage in Central New York: H. L. Fairchild.

Some Physiographic Features of the Shawangunk Mountains: George Burbank Shattuck.

Nantucket Shorelines III.: F. P. Gulliver.

Nantucket Shorelines IV.: F. P. Gulliver.

Note on Striations and U-Shaped Valleys Produced by other than Glacial Action: Edmund Otis Hovey.

Cartographic

Paleogeography of North America: Charles Schuchert.

Historical Notes on Early State Surveys: George P. Merrill.

Economic

The Iron Ores of Maryland: Joseph T. Singewald, Jr.

The Shortage of Coal in the Northern Appalachian Field: I. C. White.

Symposium on Correlation

Principles of Pre-Cambrian Correlation: C. R. Van Hise.

The Basis of Pre-Cambrian Correlation: F. D. Adams.

Evolution of Early Paleozoic Faunas in Relation to Their Environment: C. D. Walcott.

Physical and Faunal Evolution of North America in the late Ordovicic, Siluric and Devonic Time: A. W. Grabau.

Correlation of Middle and Upper Devonian and Mississippian Faunas of North America: Stuart Weller.

Physical and Faunal Changes of Pennsylvanian and Permian in North America: G. H. Girty.

The Upper Paleozoic Floras, Their Succession and Range: David White.

Environmental Relations of the Early Vertebrates: S. W. Williston.

Environment and Relations of the Cenozoic Mammalia: H. F. Osborn.

Succession and Distribution of Later Mesozoic Invertebrate Faunas: T. W. Stanton.

Conditions Governing the Evolution and Distribution of Tertiary Faunas: W. H. Dall.

Environment of the Tertiary Faunas of the Pacific Coast: Ralph Arnold.

Succession and Range of Mesozoic and Tertiary Floras: F. H. Knowlton.

Physical Geography of the Pleistocene with Special Reference to Conditions Bearing on Correlation: R. D. Salisbury.

Origination of Self-generating Matter and the Influence of Aridity upon Its Evolutionary Development: D. T. MacDougal.

Diastrophism as the Ultimate Basis of Correlation: T. C. Chamberlin.

Relationship of the Pennsylvanian and Permian Faunas of Kansas and Their Correlation with Similar Faunas of the Urals: J. W. Beede.

Glacial Character of the Yosemite Valley: François Matthes.

Age and Geologic Relations of the Sankaty Beds, Nantucket: W. O. Crosby.

Age and Relations of the Sankaty Beds: H. W. Shimer.

The Mills Moraine with some Discussion of the Glacial Drainage of the Longs Peak (Colo.) District: Edward Orton, Jr.

LIST OF PAPERS READ BEFORE THE ASSOCIATION OF AMERICAN GEOGRAPHERS

A short account was sent to Science by the secretary of the Association of American Geographers.[4]

President Gilbert's address, "Earthquake Forecasts."

Professor Albrecht Penck gave a lecture on "The Relation between Climate, Soil and Man," on Thursday evening, December 31.

Round Table Conference on Geography for Secondary Schools: Richard Elwood Dodge.

[4] Vol. XXIX., pp. 273–275.

Some Undescribed Features of the Yellowstone National Park: WILLIAM LIBBEY.

Accumulation of Inherited Features in Shorelines of Elevation: J. W. GOLDTHWAIT.

The Origin of Loess Topography: G. E. CONDRA.

The Stream Robbery on which the Belle Fourche Reclamation Project is Based: N. H. DARTON.

Delta Form and Structure of the Thames River Terraces, Connecticut: F. P. GULLIVER.

On the Elements of the Surface Sculptured by Valley Glaciers: WILLIAM HERBERT HOBBS.

Existing Glaciers of the Western Hemisphere: O. D. VON ENGELN.

Map Criticism: CYRUS C. ADAMS.

The Topographer's A B C of Land Forms: FRANÇOIS E. MATTHES.

The Principles of Topographic Delineation: FRANÇOIS E. MATTHES.

The Topographic Base Map of Alaska: ALFRED H. BROOKS.

The Requisites of a School Wall Map: J. PAUL GOODE.

How may the Teaching of Geography in Elementary Schools be Improved? C. T. MCFARLANE.

On Apparatus for Instruction in the Interpretation of Maps: WILLIAM HERBERT HOBBS.

Three Gatherings of Geographic Interest: ALBERT PERRY BRIGHAM.

Status of the Magnetic Survey of the Earth: L. A. BAUER.

A Reconnaissance in the Arctic Slope of Alaska: ERNEST DE KOVEN LEFFINGWELL.

The Climate of Cuba: HENRY GANNETT.

The Temperature at Great Heights above the American Continent: A. LAWRENCE ROTCH.

The Cyclonic Unit in Climatological Investigations: R. DEC. WARD.

The Climate of the Historic Past: ELLSWORTH HUNTINGTON.

Origin of Civilization Through Intermittency of Climatic Factors: J. RUSSELL SMITH.

The National Forest Policy: HERBERT A. SMITH.

A Proposed Ecological Survey in Illinois: HENRY C. COWLES.

Decrease in Population in the Plateau Region of Central New York: RALPH S. TARR.

Locations of Towns and Cities in Central New York: RALPH S. TARR.

Some Anthropogeographic Effects of Glacial Erosion in the Alps: N. M. FENNEMAN.

Results of Recent Census of Cuba: HENRY GANNETT.

The Anthropography of Some Great Cities: MARK JEFFERSON.

The Capacity of the United States for Population: ALBERT PERRY BRIGHAM.

The Reservoir Systems of Flood Protection in the Light of the Recent Floods of the Mississippi River: ROBERT M. BROWN.

Geographical and Other Influences Affecting the Pottery Industry of Trenton, N. J.: RAY HUGHES WHITBECK.

Geographical Influences in the Development of Ohio: FRANK CARNEY.

Trade Routes in the Economic Geography of Bolivia: ISAIAH BOWMAN.

The Geography of Wisconsin: LAWRENCE MARTIN.

The Geographic Distribution of Culture: MARK JEFFERSON.

The Influence of the Precious Metals on American Exploration, Discovery, Conquest and Possession: GEORGE DAVID HUBBARD.

Some Practical Results of the Ninth International Geographical Congress: H. G. BRYANT.

A Remarkable Glacial River and Its Modern Representative: F. B. TAYLOR.

The Baltimore meeting was one of great interest to geologists and geographers, not only on account of the large number of papers presented, many of which had to be read by title, but also because there were so many opportunities to meet men from different sections of the country and to discuss and compare individual fields of work, without which great advance in science can not be made. Great credit should be given to the members of the Geological Department of Johns Hopkins University for the arrangements of the details of the meeting.

F. P. GULLIVER,
Secretary Section E

SOCIETIES AND ACADEMIES

TWENTY-FIFTH MEETING OF THE CHICAGO SECTION OF THE AMERICAN MATHEMATICAL SOCIETY

THE twenty-fifth meeting of the Chicago Section of the American Mathematical Society was held at the University of Chicago on Friday and Saturday, April 9 and 10, 1909. The attendance upon the various sessions numbered over sixty, including forty-six members of the society. On Friday evening forty members dined together in the café of the university commons, and discussed informally various topics of interest, including the plans for the meeting of the British Association for the Advancement of Science to be held in Winnipeg this summer, and the next International Congress of Mathematicians to be held in England in 1912.

Particular interest centered in the report of the committee appointed at the previous meeting, of which Professor E. J. Wilczynski was chairman, and whose purpose was to devise a plan by which it might be possible for the society to aid in securing better methods of making mathematical appointments in the colleges and universities of this country. The paper read by Professor Wilczynski at the preceding meeting was published in full in SCIENCE for February 26, 1909. The committee reported that they had been unable to recommend for consideration any plan for improvement by action of the society. But, nevertheless, the members of the section were greatly interested in the details of a plan proposed by Professor Wilczynski and formally requested the secretary to incorporate this in the minutes of the meeting.

Twenty-six papers were presented at the four half-day sessions of the section, all of the authors being present except Dr. Ranum and Professors Ames and Davis, whose papers were read by title.

Following are the titles of papers and the authors:

On a Class of Discontinuous Functions of Two Variables: Professor C. N. HASKINS, University of Illinois.

The Fermat Number $2^{256}+1$: Mr. A. E. WESTERN, London, England; Dr. J. C. MOREHEAD, Northwestern University.

A Simplification of Lagrange's Method for the Solution of Numerical Equations: Dr. J. C. MOREHEAD.

Oscillations near Lagrange's Equilateral Triangle Points in the Problem of Three Bodies: Mr. THOMAS BUCK, University of Chicago.

On the Equivalence of Pairs of Quadratic Forms under Rational Transformations: Professor L. E. DICKSON, University of Chicago.

The Group of Classes of Quadratic Integers with Respect to a Composite Ideal as Modulus: Dr. ARTHUR RANUM, Cornell University.

On Surfaces having Isotherm-conjugate Lines of Curvature: Professor A. E. YOUNG, Miami University.

A Set of Criteria for the Summability of Divergent Series: Professor W. B. FORD, University of Michigan.

On the Determination of the Asymptotic Developments of a Given Function: Professor W. B. FORD.

A Class of Periodic Orbits of Three Finite Bodies: Mr. H. E. BUCHANAN, University of Chicago.

Automorphisms of Order Two: Professor G. A. MILLER, University of Illinois.

The Attack on the Space and Time Concepts by Einstein and Minkowski: Mr. R. P. BAKER, University of Iowa.

An Imaginary Conic: Professor E. W. DAVIS, University of Nebraska.

Groups of Rational Integral Transformations in a General Field: Dr. L. I. NEIKIRK, University of Illinois.

A Theory of Invariants: Professor L. E. DICKSON.

Combinants: Professor L. E. DICKSON.

Maschke's Symbolic Method Applied to some Questions in Geometry of Hyperspace: Mr. W. H. BATES, Purdue University.

A Simpler Proof of Lie's Theorem for Ordinary Differential Equations: Professor L. D. AMES, University of Missouri.

Periodic Orbits about an Oblate Spheroid: Dr. W. D. MACMILLAN, University of Chicago.

On the Effect of Types of Correspondence on Bravais's Coefficient of Correlation: Professor H. L. RIETZ, University of Illinois.

Oscillating Satellites when the Finite Bodies Describe Elliptic Orbits: Professor F. R. MOULTON, University of Chicago.

Projective Differential Geometry of Developables: Professor E. J. WILCZYNSKI, University of Illinois.

Complete Elementary Theory of Certain Properties of Classes of Functions: Mr. ARTHUR PITCHER, University of Chicago.

Remarks on the General Theory of Point Sets: Mr. T. H. HILDEBRANDT, University of Chicago.

Biorthogonal Systems: ANNA JOHNSON PELL, University of Chicago.

On the Solution of Linear Differential Equations with Periodic Coefficients: Professor F. R. MOULTON, Dr. W. D. MACMILLAN, University of Chicago.

H. E. SLAUGHT,
Secretary of the Section

THE TORREY BOTANICAL CLUB

THE meeting of March 9, 1909, was called to order at the American Museum of Natural History at 8:30 P.M., with Dr. E. B. Southwick in the chair. About fifty persons were present. After the reading and approval of the minutes of the preceding meeting, the club listened to a very interesting lecture on "Ferns," by Mr. Ralph C. Benedict. The lecture was illustrated by lantern slides made from photographs taken by the speaker.

PERCY WILSON,
Secretary

SCIENCE

FRIDAY, MAY 14, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

SOME TRENDS IN HIGHER EDUCATION[1]

THE student of the higher educational system can not help becoming impressed by certain very pronounced phenomena. These grow most obvious if the graphical method is used for the expression of tabulated data, and that method has therefore been relied upon here to visualize the movements under discussion.

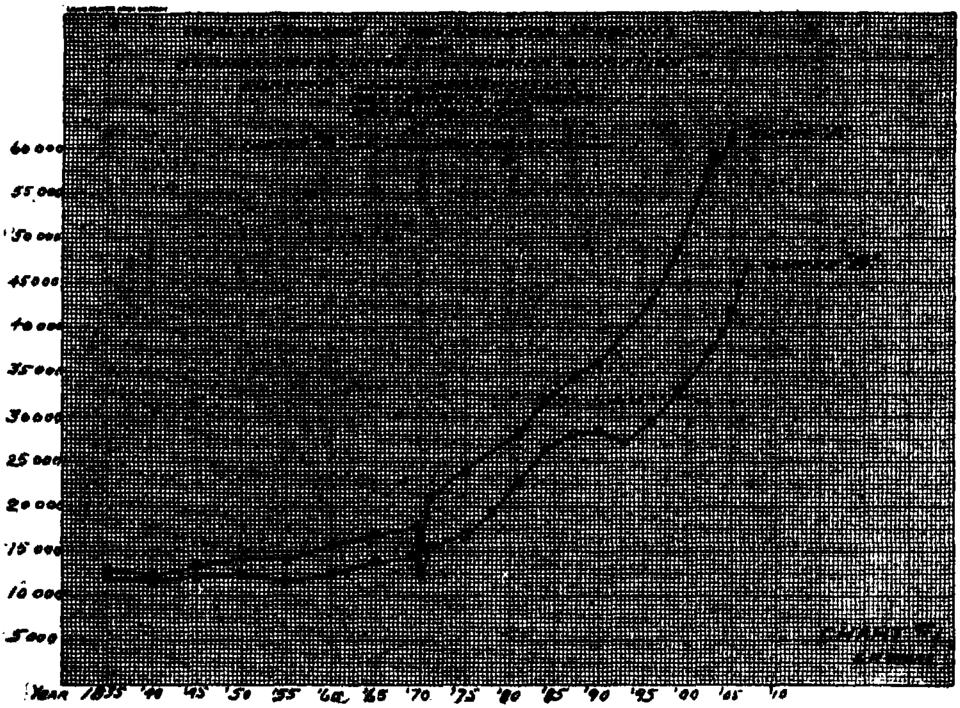
First among the phenomena, and bearing all the others in its train, is the remarkable growth and spread of interest in higher education, and the consequent tremendous increase in the number of those pursuing advanced studies and receiving higher training.

Chart No. 1 deals with the conditions in Germany as disclosed by a study of educational statistics compiled from official sources.[2] It is natural for us to look to Germany for significant educational movements and well-kept statistics. An examination of Curve B of the combined

[1] The charts which form the basis of this paper are part of those which have been constructed by the writer for his use in studying certain movements bearing upon the problem of educational efficiency. Effort has been made to have the data as complete and accurate as the time at his disposal for this work would permit, although it is too much to hope that no minor errors or discrepancies have been overlooked.

For data furnished, other than those available in official publications, he wishes to make especial acknowledgment to Presidents Schurman, Van Hise, Wheeler and Jordan and their respective secretaries.

[2] Lexis's "Public Education in the German Empire"; Ascherson's "Kalender der deutschen Universitäten" and "Minerva."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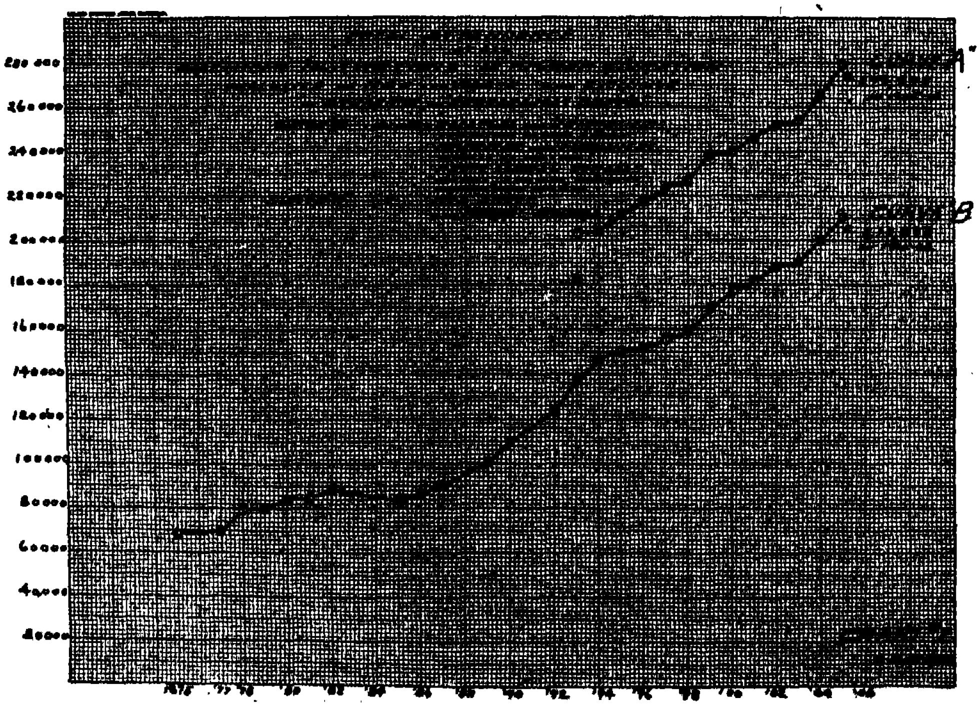
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Curve "A"
Curve "B"

attendance at the twenty-two German universities reveals at once the most striking fact developed in the course of this investigation. It will be seen that prior to 1870 (the year of the Franco-Prussian war) this attendance was fairly uniform (the yeast of the spirit of 1848–9 can, however, be seen to have been slightly working), keeping regular pace with the population and thereby betokening a certain stable condition of the social order. Immediately after this date we find the curve taking a sharp upward bend and an increase in attendance growing much more rapidly than the population. Nor does this increase show the slightest tendency to fall off. It is even more marked if we plat the combined attendance at all the German universities, polytechnic and professional colleges above gymnasial rank as in Curve A.[7]

At the beginning of the period of rapid development (1870) we find one student for every two thousand inhabitants, while in 1907 we find one student for every thousand inhabitants. This denotes twice as wide-spread a participation in the benefits of higher education—and, involving, as this must, higher personal efficiency, needs and aspirations, it is not too much to claim that we are well on the way toward an entirely new social order; that we are in the midst of an intellectual renaissance of profoundest import, of a movement which is one of the most significant in the history of the development and progress of the race.

Were Germany alone in this movement so broad a statement would be unjustifiable—but she does not stand alone, she is simply preceding the other nations.

Chart No. 2 deals with the statistics for the United States and is based upon data compiled from annual Reports of the Commissioner of Education. Curve B gives the combined attendance at all the colleges, universities, scientific, technical and professional schools, omitting preparatory departments. Up to the year 1885 we see a condition of practical stability, but beginning with that year the curve takes an upward bend and continues with no sign of falling off. We see repeated the same story told by the German curves but beginning fifteen years later. In 1885 we find one student for every seven hundred inhabitants, twenty years later, in 1905, one for every four hundred —or, if we include the Normal School attendance as given by Curve A, one for every three hundred inhabitants.

Even though the United States shows the same phenomenon, our broad statement might have to be qualified. But the following table (I.) shows that the movement is not confined to these two countries. Here we see that Russia is the only western country of prominence which has not passed Germany's figure of the year 1870, namely, one student for two thousand inhabitants. Perhaps the most striking fact displayed by this table is the way Great Britain has lagged in this vast movement of the democratization of the advantages of higher education—and, scarcely less significant, the strong leading position of the United States.

To analyze the forces underlying this great wave of emancipation, fascinating as the study may be, is a task lying beyond our present powers. It remains a problem for the future historian. We must content ourselves with noting the phenomenon and passing on to some of its effects. It is also to be noted in passing that going side by side with the great increase in numbers there has been a vast improvement in the standards of the edu-

[7] The disturbed political conditions of 1887–8 show in the form of an offset in both curves; more marked in B.

TABLE I

Country	Population[3]	Number of Students in Higher Educational Institutions	Population per Student
United States	84,000,000	210,333[4]	400
		279,270 (Inc. Normal Sch.)	[300]
Switzerland	3,500,000	6,500[6]	530
Germany	61,000,000	61,267 Matriculates[6]	1,000
		75,639 Incl. hearers	[800]
Sweden	5,300,000	5,000[5]	1,060
France	39,000,000	32,000[5]	1,200
Roumania	6,000,000	5,000[5]	1,200
Italy	33,000,000	24,000[5]	1,400
Belgium	7,100,000	5,000[5]	1,400
Holland	5,600,000	4,000[5]	1,400
Austria-Hungary	47,000,000	30,000[5]	1,570
Spain	19,000,000	12,000[5]	1,600
Great Britain	44,000,000	25,000[5]	1,750
Russia	147,000,000	23,000	6,400

cational institutions as affecting both their entrance requirements and their own grade of work. Whether as cause or effect there has also accompanied this wonderful growth a remarkable broadening of curriculum and quite a complete change of emphasis on what constitute the essential factors of higher training.

TABLE II

Ratios of Attendance of Various Courses at the German Universities, Technical and Professional Colleges

Faculty	1830	1869	1905		Ratio 1869/1830	Ratio 1905/1869
Universities						
Theology	6,076	2,986	3,846		0.49	1.29
Law and Finance	4,502	3,178	12,456		0.71	3.92
Medicine (Including Dentistry)	2,355	3,140	6,142		1.33	1.96
Philosophy (Incl. Philology, Mathematics and Science)	2,937	4,853	19,494		1.65	4.03
Polytechnica						
Architecture and Civil Engineering[8]		942[8]	5,4[illegible]3			5.75
Mech. and Elec. Engineering[8]		241[8]	5,161			21.50
Chemical Technology		213[8]	1,431			6.70
Special Branches		418[8]	1,577			3.77
Professional Colleges						
Mining		144	686	[835 Incl. hearers]		4.77
Forestry		306	309	[366 " "]		1.01
Agriculture		357	1,517	[1,698 " "]		4.25
Veterinary Medicine		267	1,120	[1,260 " "]		4.20
Commercial Universities			1,076	[3,098 " "]		

Unless otherwise stated, the numbers are for matriculated students only. The ratios are for matriculates.

Population: 1869: 40,805,000; 1905, 60,314,000. Ratio: 1905/1869, 1.5.

[3] Population from "World's Almanac—1908."

[4] Includes both sexes in colleges, universities, technical and professional schools, exclusive of preparatory departments, 1905–6.

[8] Original data not segregated.

[5] Universities only. Figures taken from SCIENCE, September 25, 1908, for 1907.

[6] Includes universities, technical and professional schools above gymnasial rank, 1905–6.

It is of interest to compare this vast and increasing throng of students to a powerful stream which, refusing longer to be confined within narrow, artificial banks, has burst through and found its own natural channels. What these have been can be seen from the foregoing table (II.), comparing the German student attendance in the various channels of work for the years 1869 and 1905.

The following table (III.), comparing American and German attendance, also throws light upon this phase of our subject.

TABLE III

Comparison of Attendance of Various Courses in Germany and the United States 1905–6

	United States	Germany	Ratio $\frac{U.S.}{G.}$
Population	83,935,000	60,314,000	1.39
Theology	7,968	3,846	2.07
Law	15,411	12,456	1.22
Medicine	24,924	6,142	4.05
(Incl. Dent. and Pharmacy)	36,945		[6.01]
Philosophy or Liberal Arts	94,200[10]	19,494	4.83
Arch. and Civ. Engineering[9]	10,200[10]	5,443[11]	1.86
Mech. and El. Engineering[9]	15,150[10]	5,161	2.95
Chemical Technology	1,420[10]	1,431	1.00
Mining	3,260[10]	686	4.75
Agriculture	5,000[10]	1,517	3.3
Veterinary Medicine	1,445	1,120	1.29

Data from Ascherson, Lexis, Minerva and Report of U. S. Commissioner of Education, 1906.

In making this comparison too definite conclusions must not be drawn, as the writer is well aware of the differences in standards and curricula. Thus it is probable that quite one half of our collegiate students are doing work of German gymnasial grade. In the technical and professional fields it is possible that the work is more nearly commensurate. Another item not indicated here is the much larger proportion of women students in the United States. However, this broad subject of comparison can only be touched upon and left with the statement that American standards are rapidly improving, more rapidly than they are aware who have not been giving attention to the subject.

In the light of these charts and figures is it too much to claim that they betoken a rapid breaking down of old forms of caste, class and privilege—a great social upheaval signaling the imminence of a new social order? Can no connection be traced between this increasing stream of trained young men and women taking up their duties of citizenship, and the great wave of awakening to a higher sense of social obligation and civic righteousness now rising in our country?

It is folly to dream of checking this mighty stream or of turning it back into the banks of a narrow scholasticism. Our problem is to provide adequate and suitable channels for it. Conditions are rapidly changing and we, as educators, must face the facts as they are.

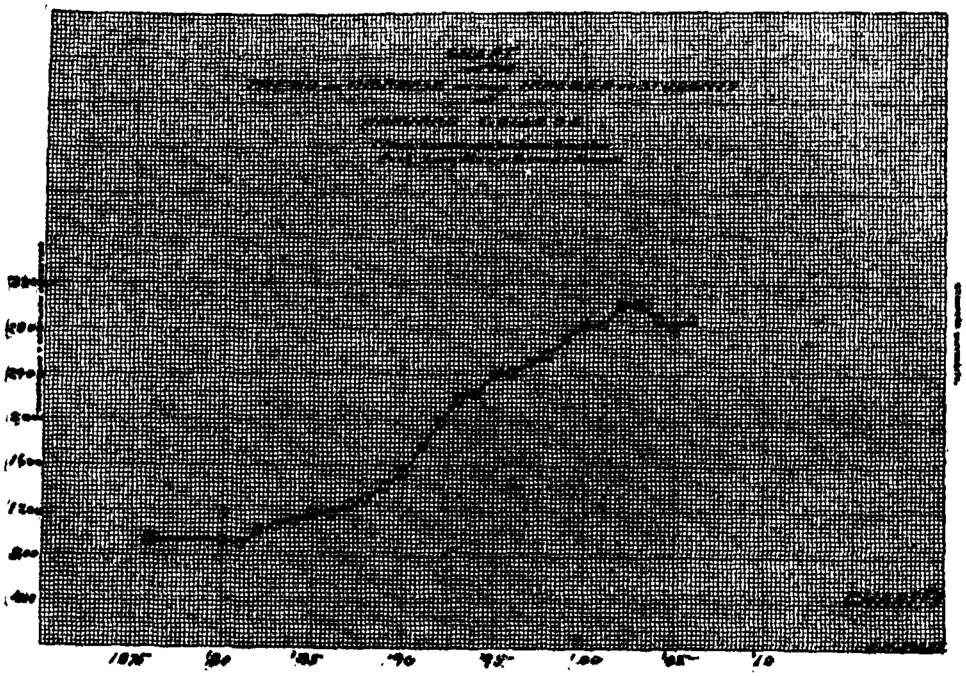
[9] Not segregated in German data. In United States, 900 Arch., 9,300 C. E. and 2,700 Gen'l Eng.

[10] Computed on basis of returns for 86.5 per cent. of total. See Report U. S. Commissioner of Education, 1906, p. 446.

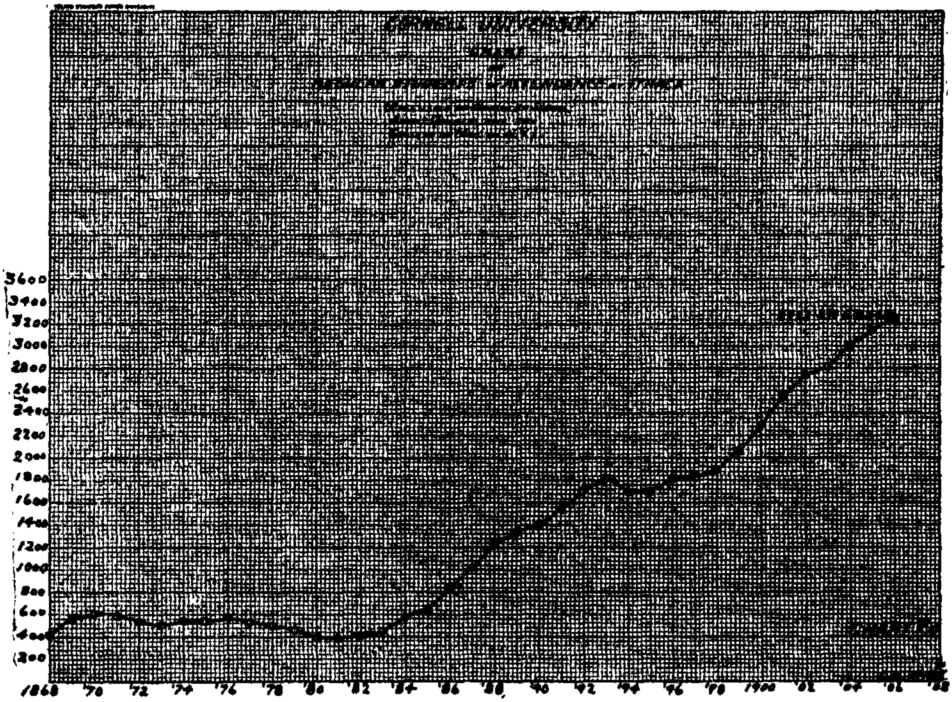
[11] In 1902 there were 1,095 Arch. and 2,852 C. E. On a proportionate division this gives in 1905–6, 2,220 Arch. and 3,223 C. E.

The profound demand of this army of nearly three hundred thousand students in our country to-day is for an education which will enable them to live most worthily and effectively the life of to-day and to-morrow. The demand, which will not be denied, is for breadth of culture coupled with an effective bearing upon the needs and problems of life—a culture whose key-note shall be efficiency in action and service.

Charts 3–7 show the trend of growth of student body. It is interesting to remark that each one of these institutions which was established before 1885 shows the same general trend of increase, as is shown by Curve B of Chart 2, the curve of combined attendance at all higher American institutions of learning. Slight irregularities, due to local conditions, such as change of entrance requirements, etc., are, to be sure, to be observed. In common with Curve B they show the effect of the hard times following 1873 and 1893 in the form of a decided offset or sag. A similar effect may be expected in the years following 1907. It will be noted that the effect is a delayed rather than immediate one. Each chart shows a practically uniform attendance until about 1885 and then a sharp upward bend maintained with essential uniformity. Is it not strange that institutions differing widely in their nature and separated by thousands of miles geographically should experience simul-



Passing from the general aspect of our problem to certain effects brought in its train, it is significant to note the results wrought upon the individual institutions. For the purposes of this investigation five typical American universities have been selected. Geographically they form a chain across our country and in type they represent institutions resting upon private foundations, public foundations and combined public and private foundations. They are Harvard, Cornell, Wisconsin, California and Stanford.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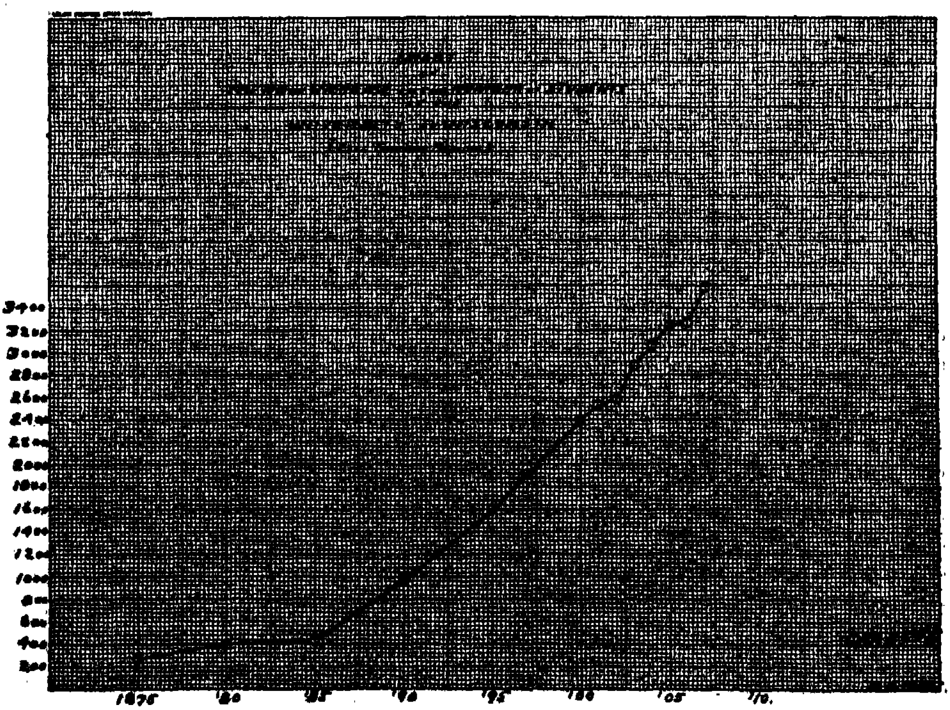
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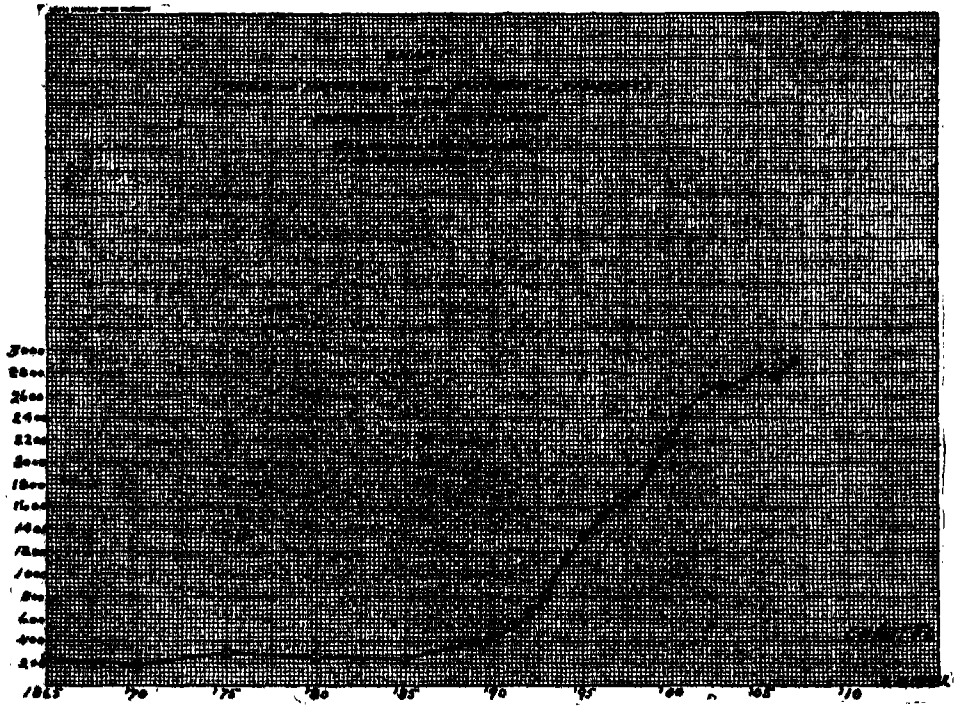
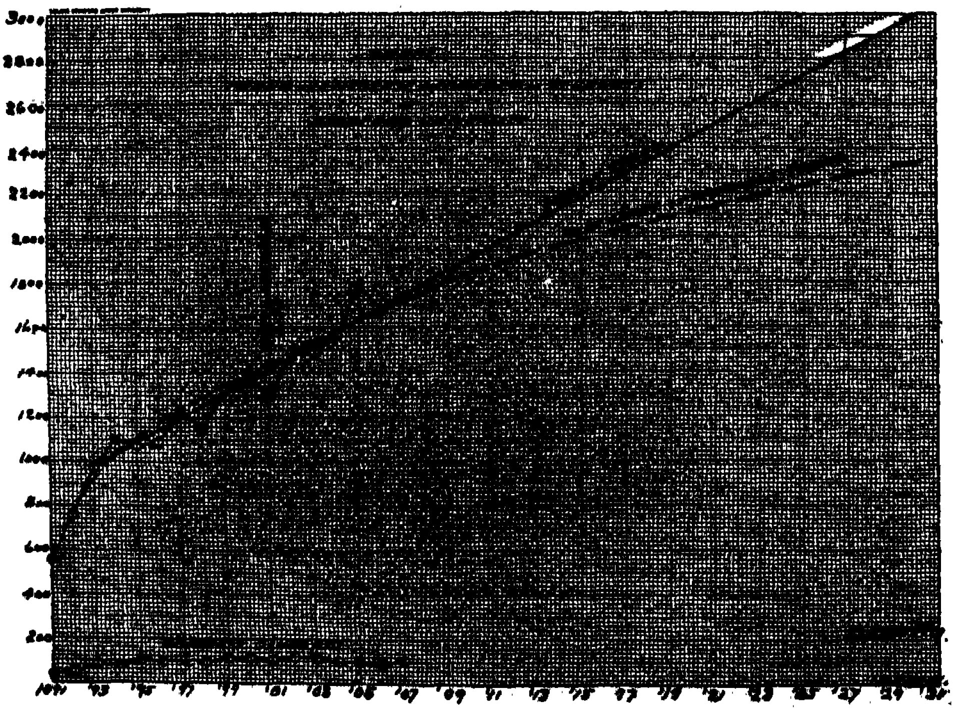
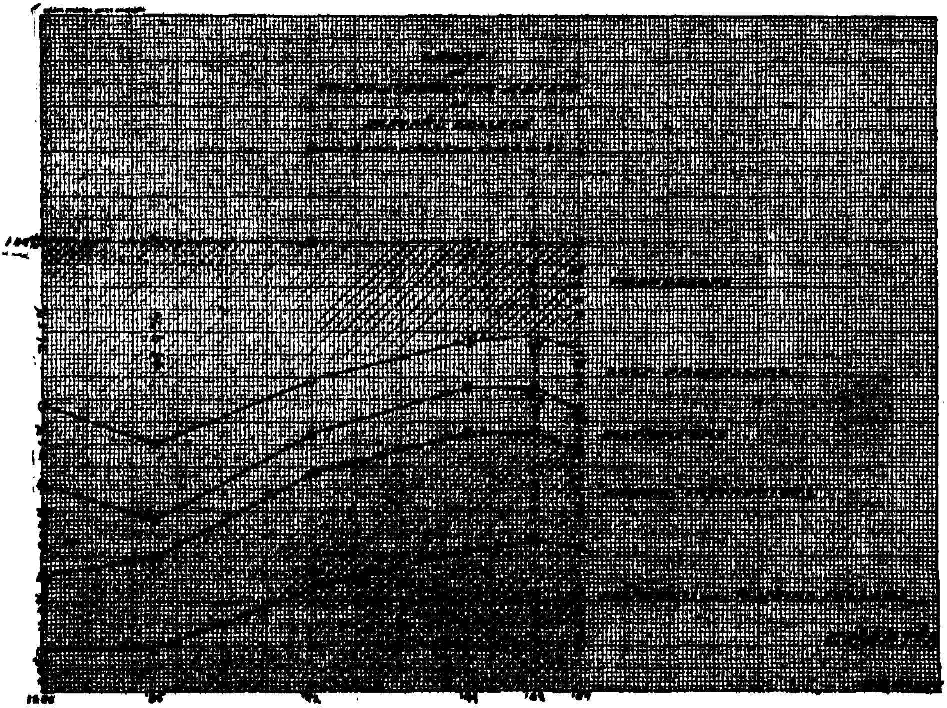




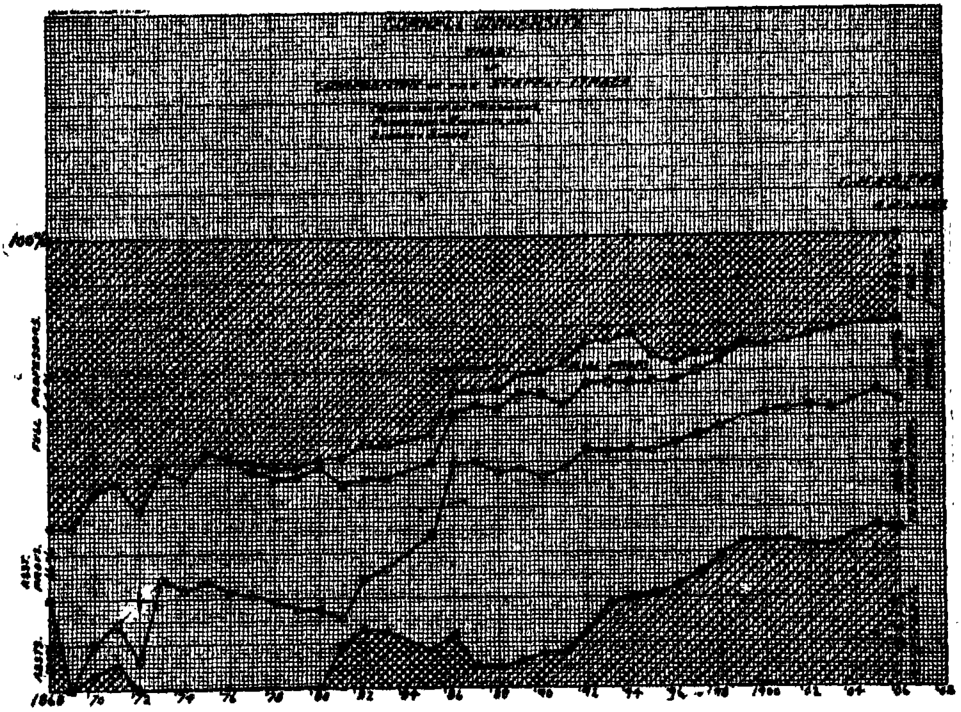
taneously this thrill of rebirth? Who shall maintain that the growth of any single institution, beginning at this time, was due to the direct action or influence of some particular individual or administration? No, this simultaneous action indicates a much more profound cause than this—an institution not to have been affected by this broad, fundamental movement must have definitely turned its back upon the demand of the times and refused to open its gates to an awakening people.



Aside from its effect upon the curricula of the institutions, a subject worthy of careful study, this rapid growth has wrought profound changes upon the nature and composition of the teaching staffs.

Charts 8 to 12 show the composition of the staffs year by year. These charts, like those of attendance, all show identically the same trends. They should be studied with reference to two items: First, the effect on the efficiency of the institution; and second, with respect to the possibilities of university teaching as a profession. In other words, first with respect to the *institution*, and, second, with respect to the *staff*.

1. It will be seen that the proportion of full professors in each staff has been a continuously and rapidly *decreasing* one, that the proportion of associate and assistant professors has remained about constant and that the proportion of instructors and assistants is most alarmingly *increasing*. The cause of these trends at all of our universities is a triple one; the rapid increase in the number of students for whom instruction is to be provided, the failure of the incomes of the institutions to keep proportionate step and a deplorable rivalry in bigness and externalism leading to unwise and unnecessary expenditures for buildings and equipment. It certainly means one thing as regards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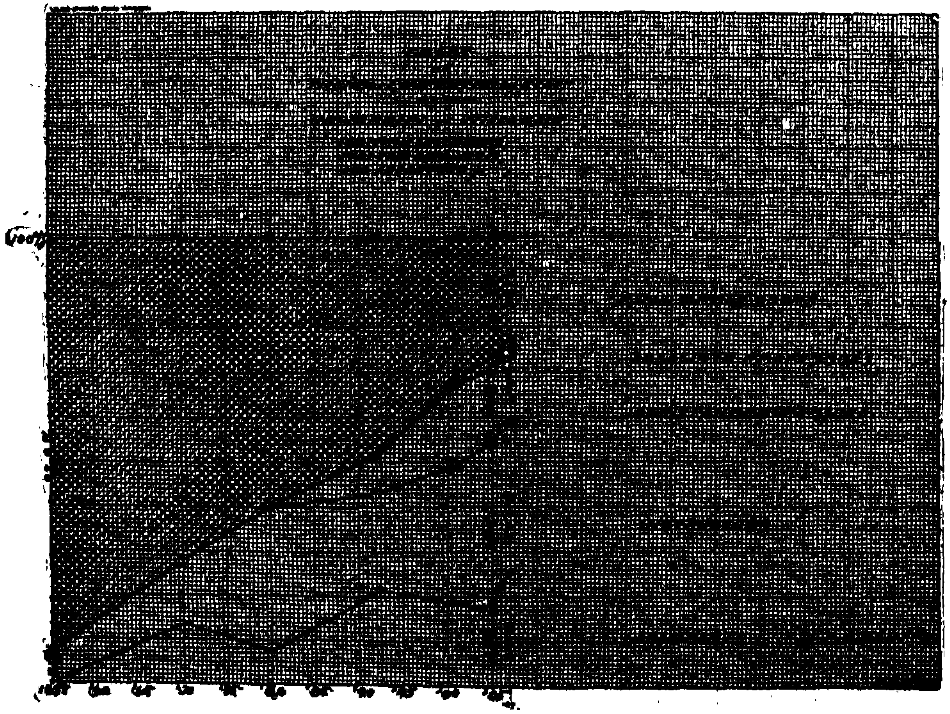
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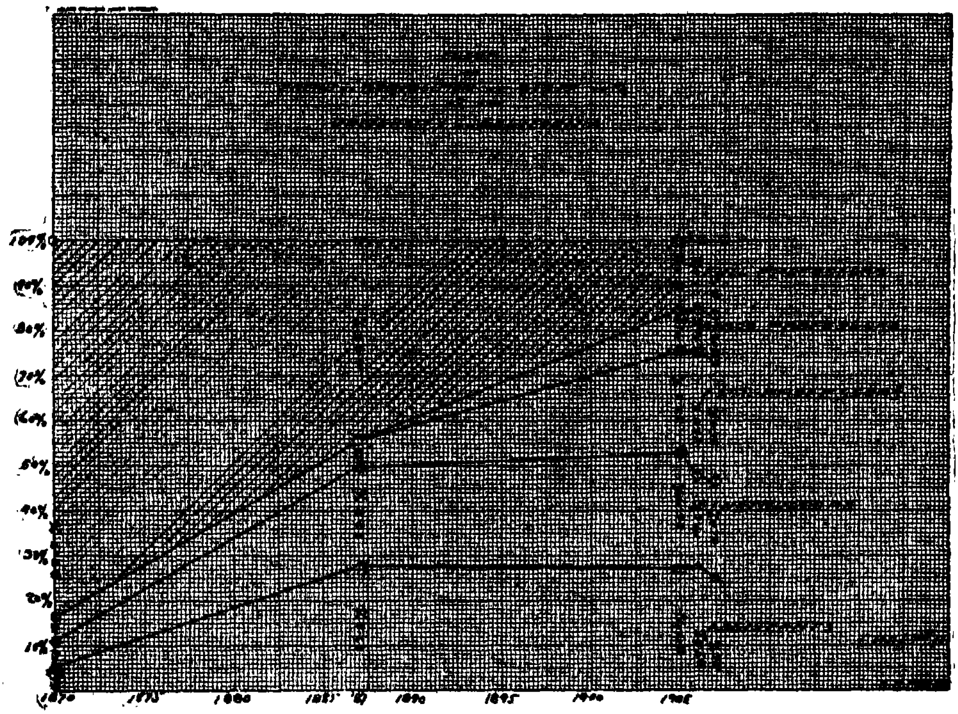
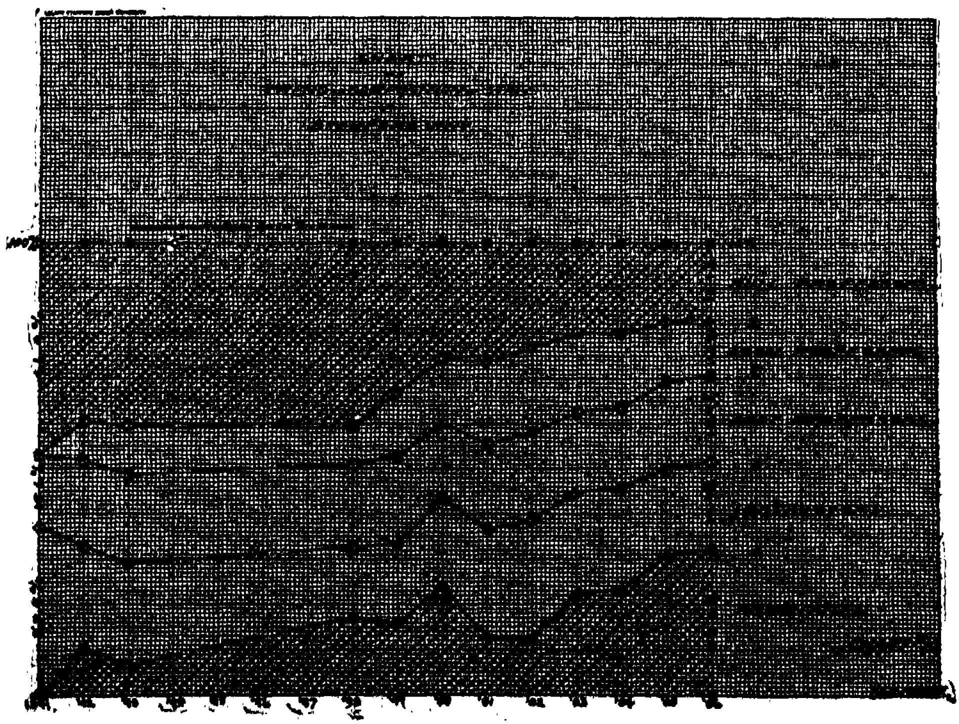




efficiency—a greater and greater share of the instruction falls upon the shoulders of the body of less experienced men and the student has a decreasing chance of working with men who have attained eminence in his line. Each recent alumnus can test the truth of this by asking himself how large a share of his work brought him into actual close and beneficial contact with the full professors in his course. Believing that the influence of personality is one of the most vital elements in training, we can but deplore the trends which separate more and more widely the student from intimate contact with men who have won recognition for success in his field of study.

Another item vitally affecting the efficiency of instruction is that this large number of instructors and assistants (from fifty per cent. to sixty-five per cent. of the staff) consists of men on temporary appointments, so that it is no unusual thing for one half of them to be entirely new appointees at the beginning of each year. The cause for this we will take up later. At present we will content ourselves by asking what can be the sole effect on the efficiency of a staff which annually loses a large proportion of somewhat trained and experienced men, whose places must be filled by beginners who must familiarize themselves with their new duties and be trained up to adequacy?

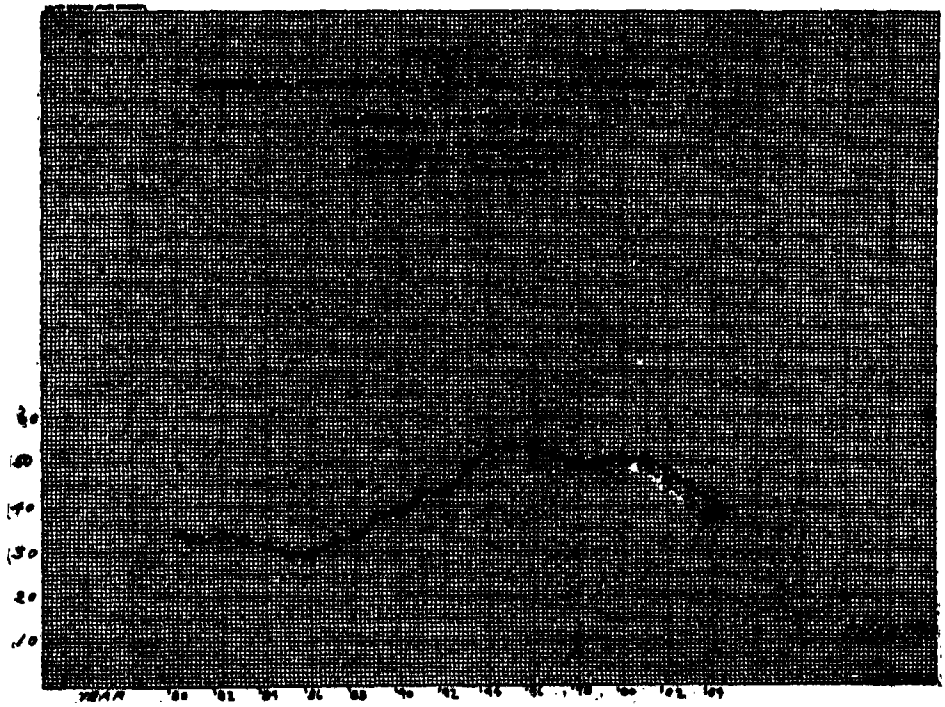
2. As regards the effect of these trends on the opportunities offered by university teaching as a profession, it need only be said that a man in the lower grades has just one third the chance of winning a place in a twenty per cent. group that he had of winning one in a sixty per cent. group. A study of the increasing average age in the ranks of associate and assistant professors at our universities bears this out.

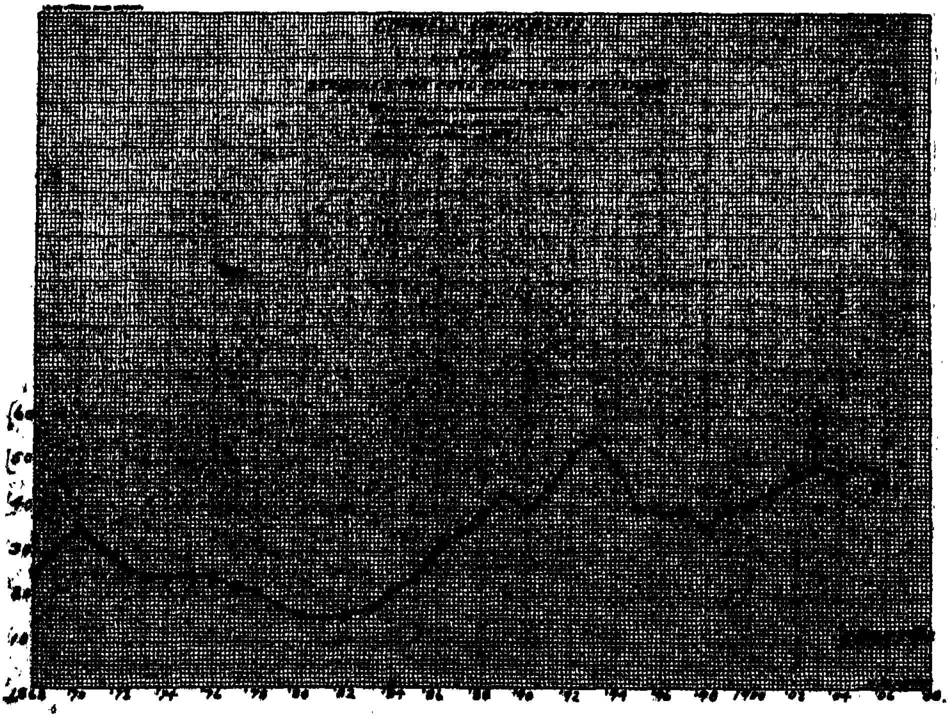
Can it be expected that young men of spirit will enter a profession which offers such decreasing chances of winning promotion, however well deserved, coupled with inadequate salary from the very start? What will be the effect on the teaching profession of a continuation of the trends shown by Charts 8 to 12? Interesting and valuable as is the recent Bulletin No. 2 of the Carnegie Foundation dealing with the "Financial Status of the Professor in America and Germany," it is of limited significance in making clear the actual conditions—for the full professors form but a small and rapidly diminishing proportion of our entire teaching staffs—a fact which seems to have escaped recognition.

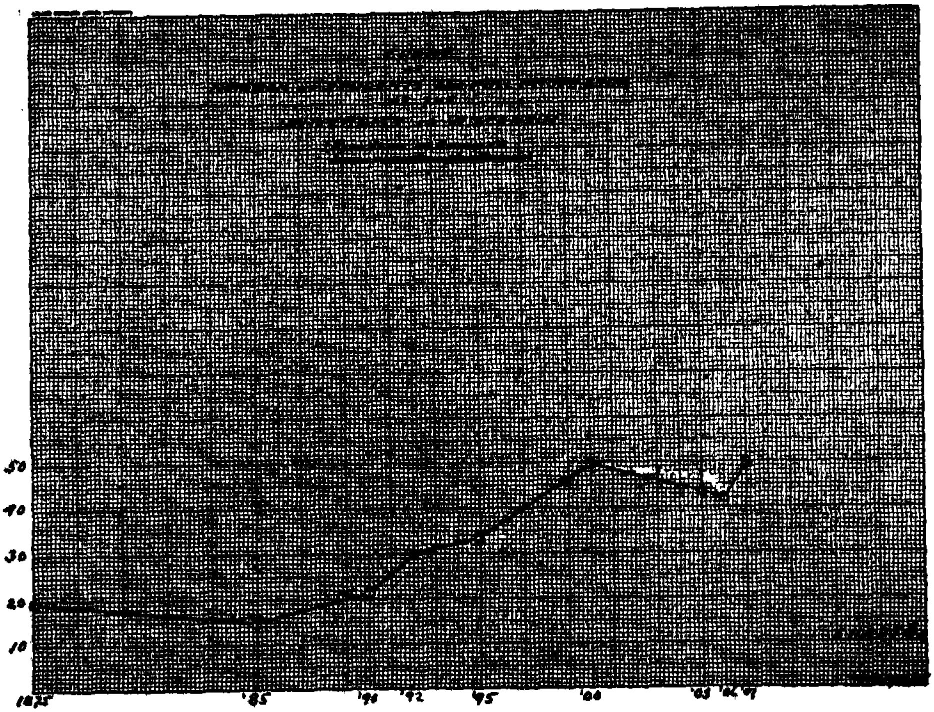
Charts 13–17 show, that while in 1885 (at the beginning of the great upward wave of attendance) there was one full professor to from fifteen to thirty students, we now find forty to eighty students per full professor. In view of these charts of composition of staff, the writer maintains that it is the instructorship and not the professorship which is the key to the situation as regards efficiency. We will return to this point after taking up the next phase of our topic.

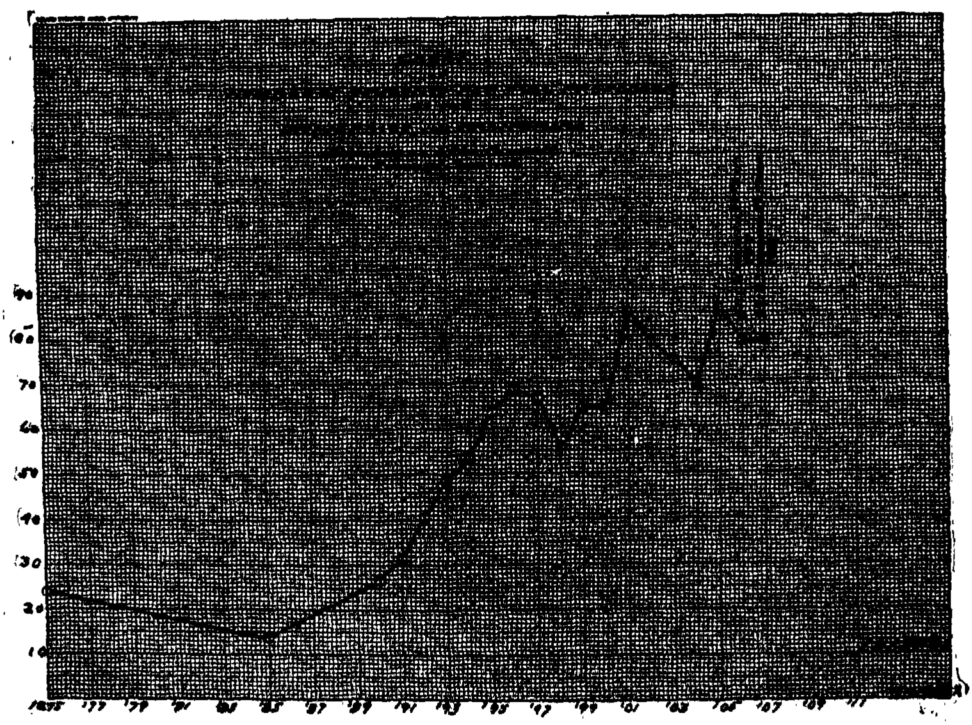
Next, approaching a vital aspect of efficient staff and service, we touch the question of trend of salaries.

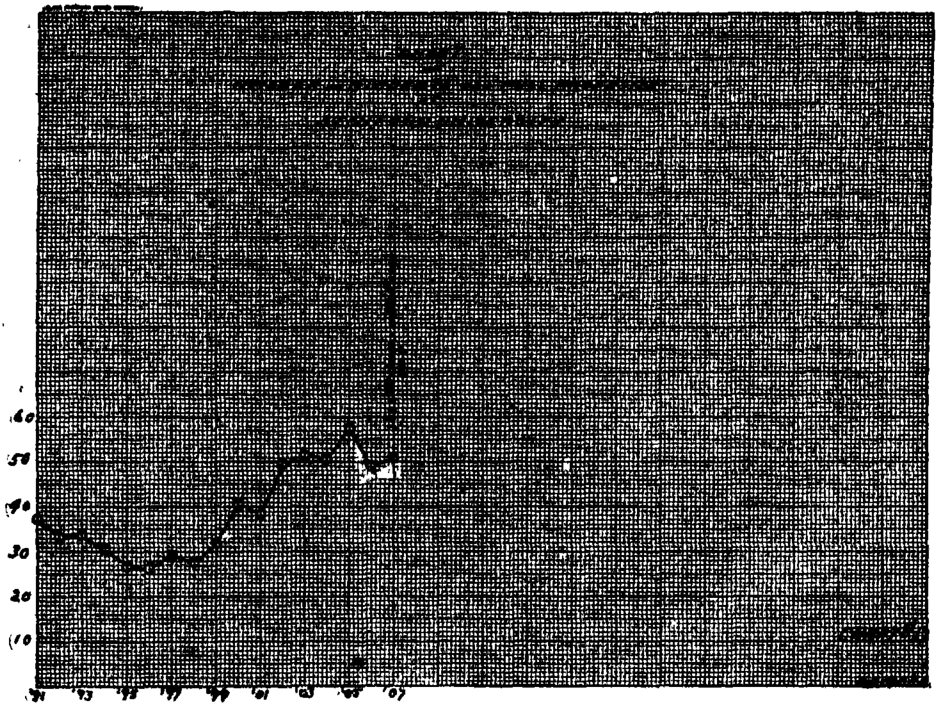
It is to be feared that the world at large fails to appreciate our fine distinctions of adjunct professors, associate professors, full professors, senior professors, deans, and directors. To the man in the street we are all "professor," weary as we may grow of the title, and he looks to us to live up to our position. If we wish to study the actual compensation to which a man in any field may look forward, it is quite significant to know the average compensation of those who may be considered as journeymen. Leaving out all under the rank of instructor as apprentices, Charts







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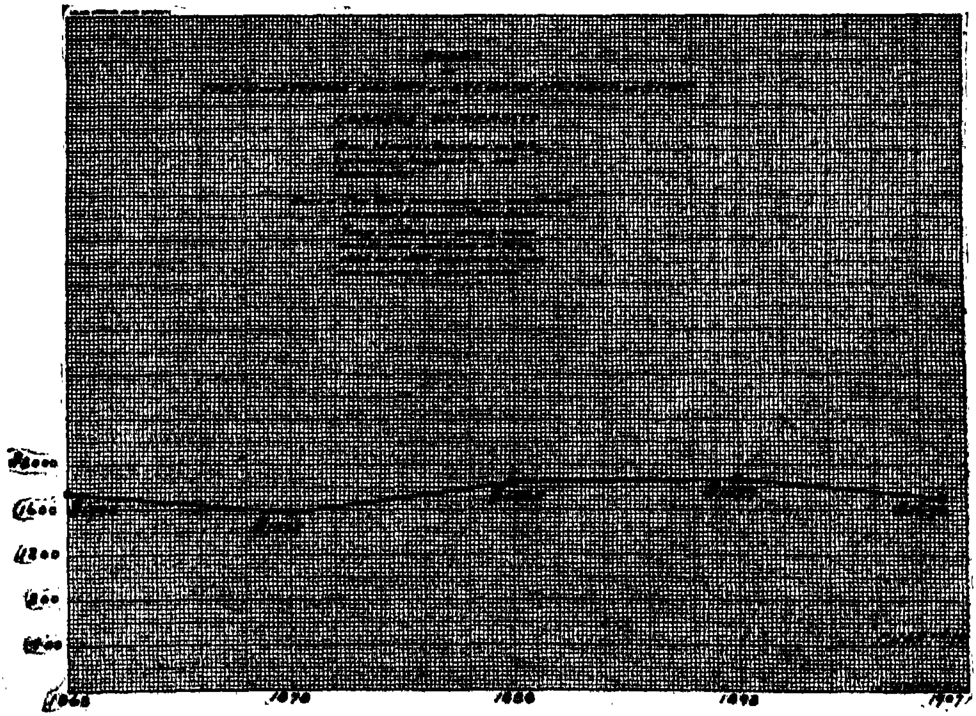
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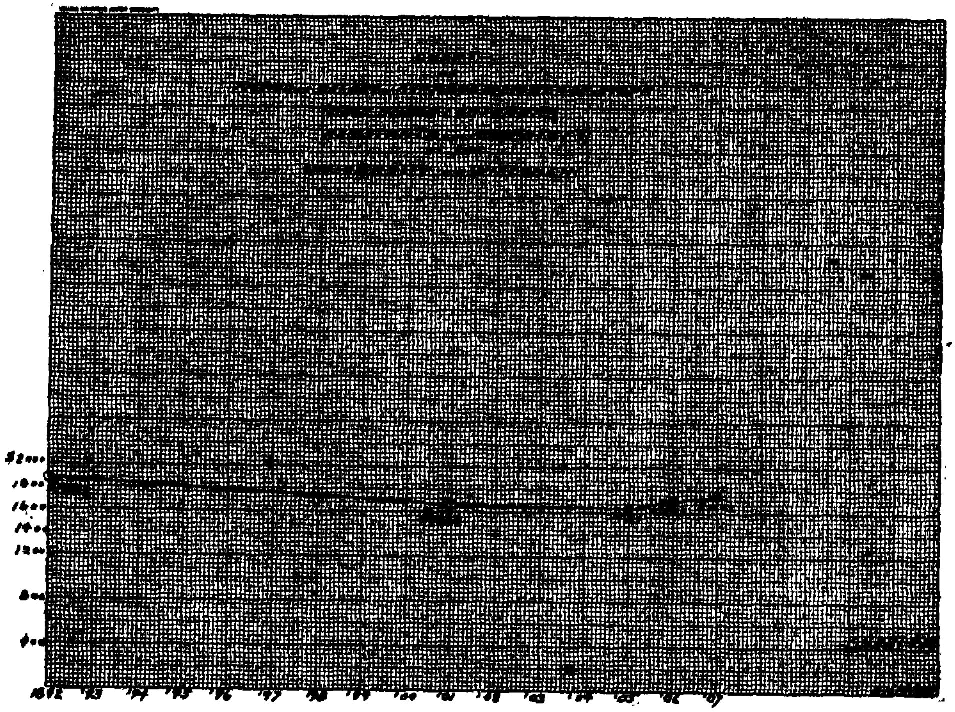
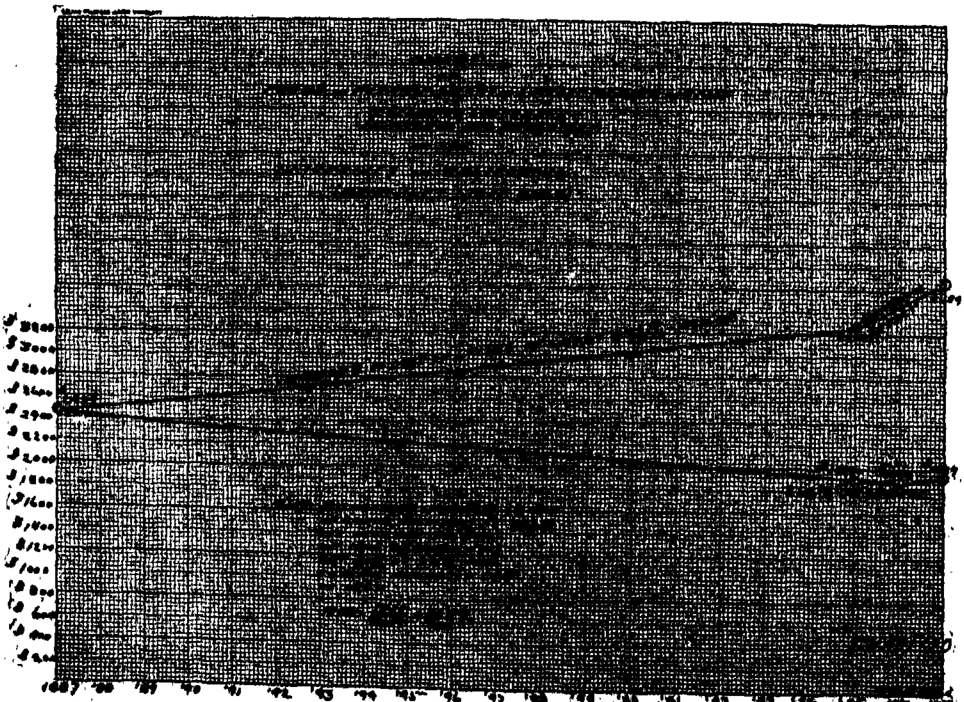
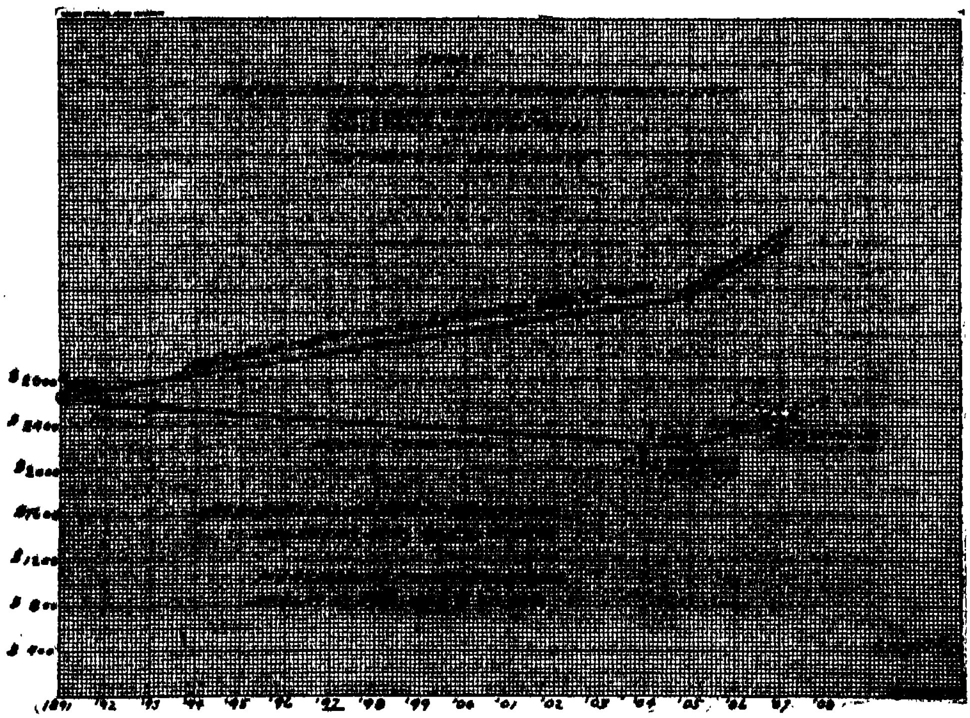




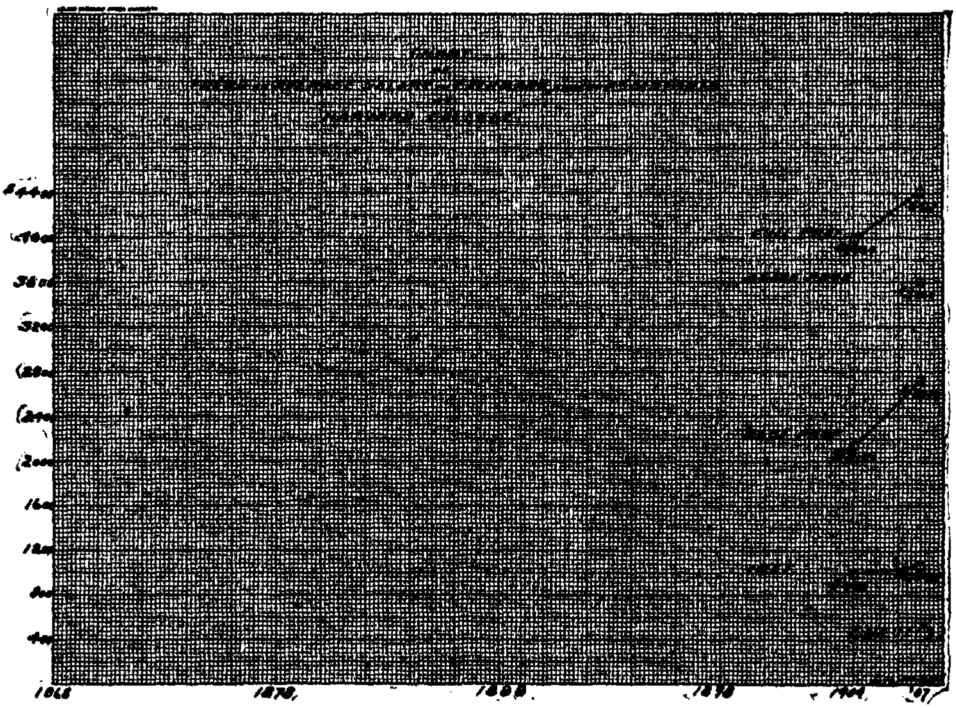
18–21 show the trend of average compensation of the average member of the staff at four of the institutions under consideration. The writer's pleas for the corresponding data for Harvard College were unfortunately unheeded.

The vitally significant thing about these charts is the downward trend of the curves for the past twenty years—a period of great increase in the cost of living. Coupling the increased cost of living, the improvement in the general standard of living (a pressure which society exerts upon every man), and the decrease in actual compensation, it is not too much to say that in purchasing power the average teacher of 1908 is but sixty to seventy per cent. as well off as was his colleague of twenty years ago. It is believed that the profession of college teaching is the only field of work in the United States—not even excepting the correspondingly poorly paid ministry—in which there has not been an increase in the average rate of compensation somewhat commensurate with the increasing cost of living. Here we see no increase in the average compensation of the profession, but an actual falling off. It may be argued that this is but a natural and legitimate consequence of recruiting so heavily the lower branches of the staff in order to keep up the proportion of teachers to students. This argument falls to the ground, however,



when we consider the increased requirements of candidates for entrance into the teaching profession over what they were twenty years ago. "The fact is that the university is at the present time able to secure for instructors as well-trained men as those who formerly received appointments as professors in the best American universities"—wrote President Schurman in one of his annual reports some

years ago. "The great and noteworthy expansion of the university, which has been brought about by the labors of the university teachers, has also been brought about at their expense," writes President Butler in one of his annual reports. Strikingly corroborative testimony is borne by a table of age of staff of Harvard College[12] in which it is seen that there was not a single member of the permanent staff under *twenty-eight* years of age.



In spite of the annual influx of new men, it is the writer's belief, based upon study of the matter, that the average age of the *instructors* at the five institutions under consideration is just about *thirty* years. This is an age at which equally trained and gifted men in other business and professional fields of activity have obtained a firm foothold and receive some reasonable pecuniary return for their services.

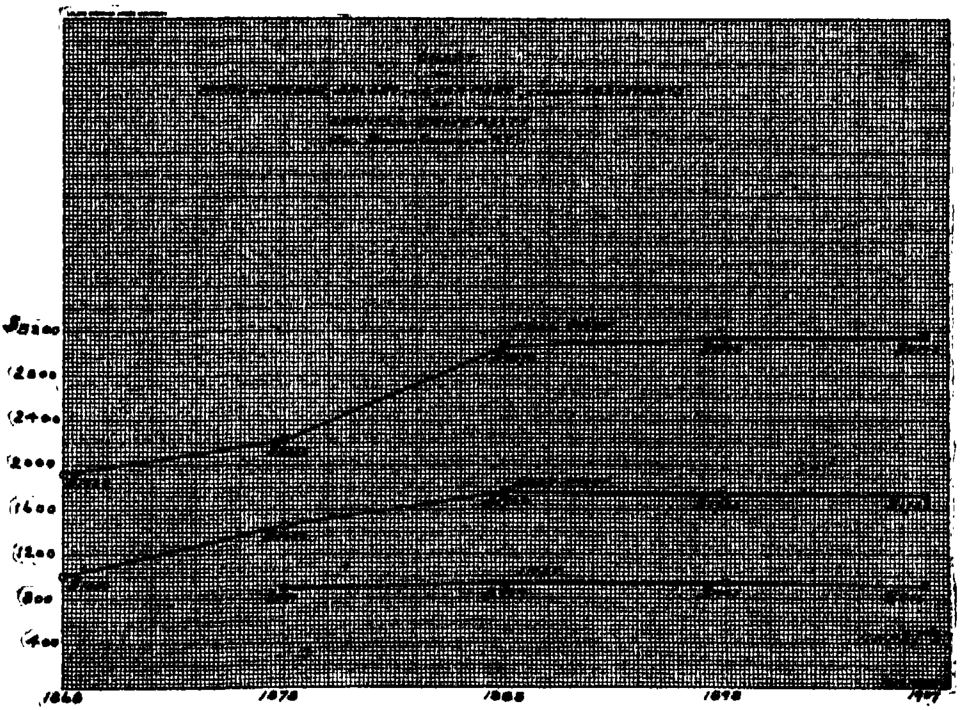
Charts 22–26 are valuable as segregating the data and showing the movement of salaries in each rank separately. In these, as in the average compensation charts, the downward trend from 1885 to 1905 is noticeable. Beginning with 1905, however, when this matter of salaries came to a sort of focus, there has been an upward trend of the salary curves at a number of institutions. Incomplete as the Harvard chart is, it is included here to show the effect of the teachers' endowment fund.

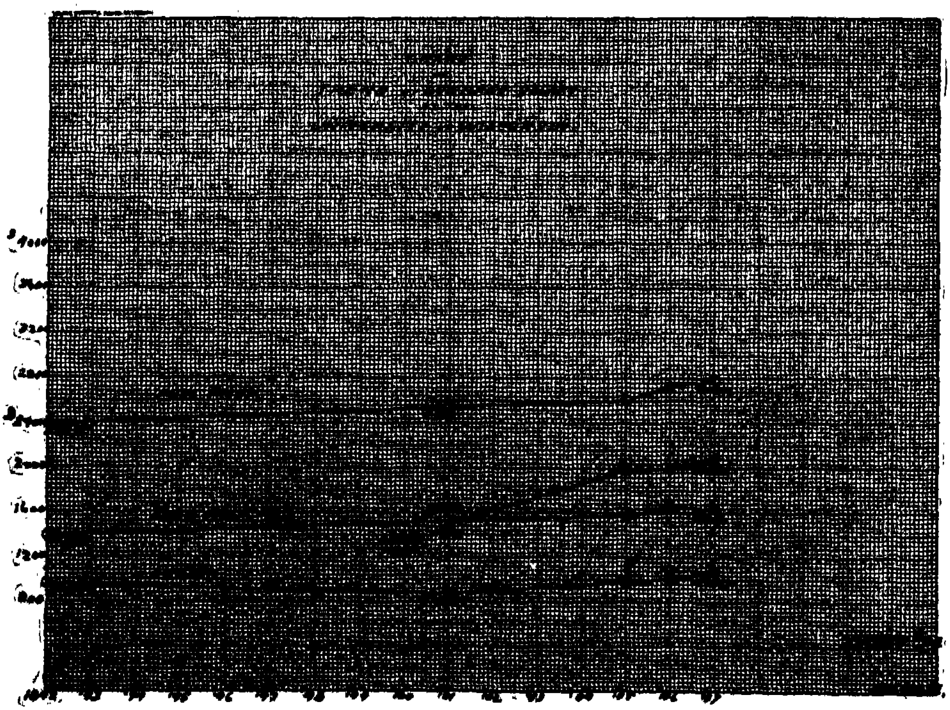
The most shocking thing revealed by a study of these charts is the status of the instructor. We have just seen what the age and training of these men is, and the large proportion they form of the entire staff; we now see that their average compensation ranges about a thousand dollars

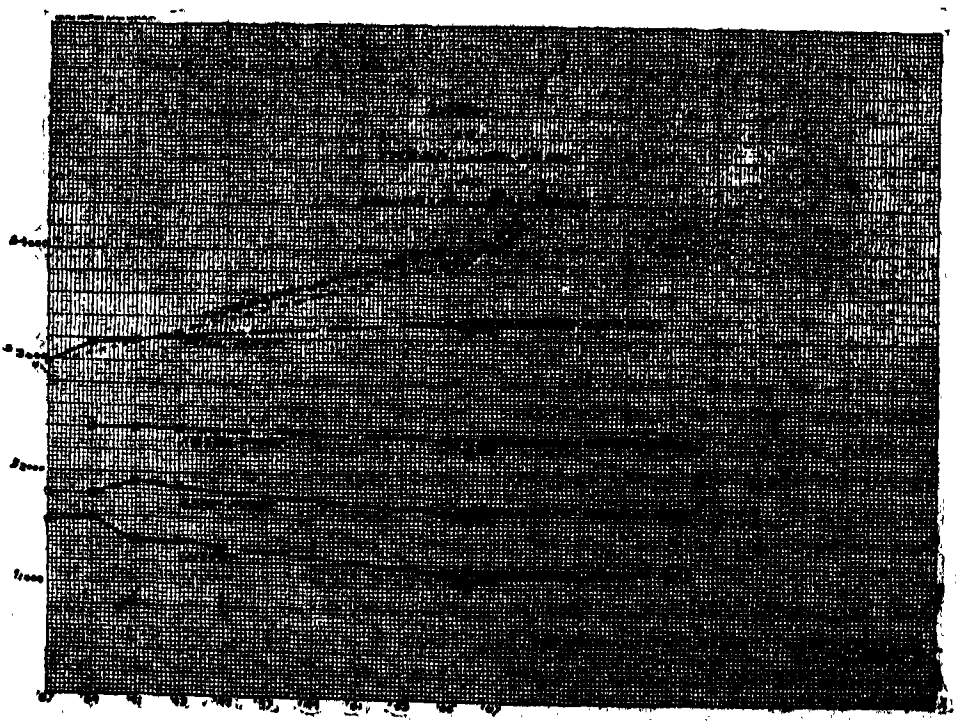
[12] President Eliot's report, 1904–5, p. 14.

a year in these leading institutions. The most serious danger which threatens the continued and developing efficiency of our universities lies in the unattractive and utterly inadequate salaries paid the instructors. Is it not well to make the portals through which all must enter the collegiate teaching profession reasonably attractive to men of character, spirit and ability? The writer is well aware of the satisfactions and rewards of the teacher's life other than financial, but should not these men for the sake of the efficiency of the institutions receive salaries somewhat commensurate with the long and expensive preparation for their life work, and *adequate to insure the possibility of their intellectual development rather than retrogression?*

Is it to be expected, otherwise, that the field of university teaching will appeal to men of suitable quality? It has been seen that it is upon these men that the greater part of the burden of the instruction falls, and within the limitations of their ranks must develop those who are to recruit the higher positions. Nine hundred or a thousand dollars a year for doctors of philosophy! Why should our universities place so very low an estimate upon the value of their own product? As if to discredit the rank still more, the rules of the Carnegie Foundation refuse to recognize the years spent in it as a teacher toward the necessary twenty-five years of service entitling one to a retiring allowance. The writer has known of able men, loyal to their institutions, who have spent fifteen years and more in this rank before receiving deserved promotion. Furthermore, most institutions rob themselves of the younger men's natural desire to pursue advanced study and to grow, by loading them down with a heavy burden of entirely elementary work—and refusing to count years of service as instructor toward

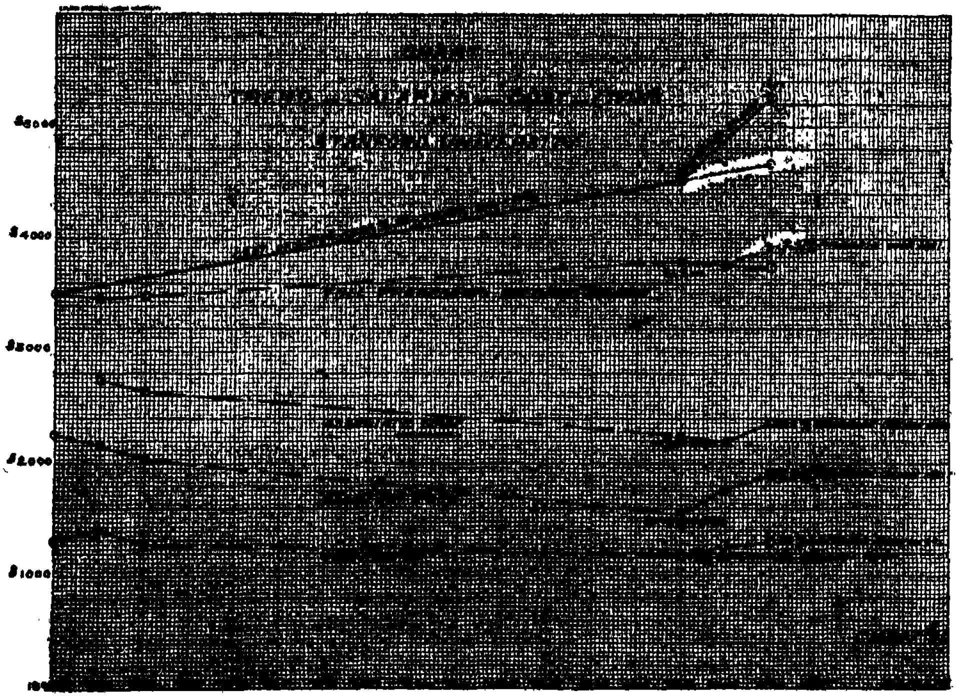




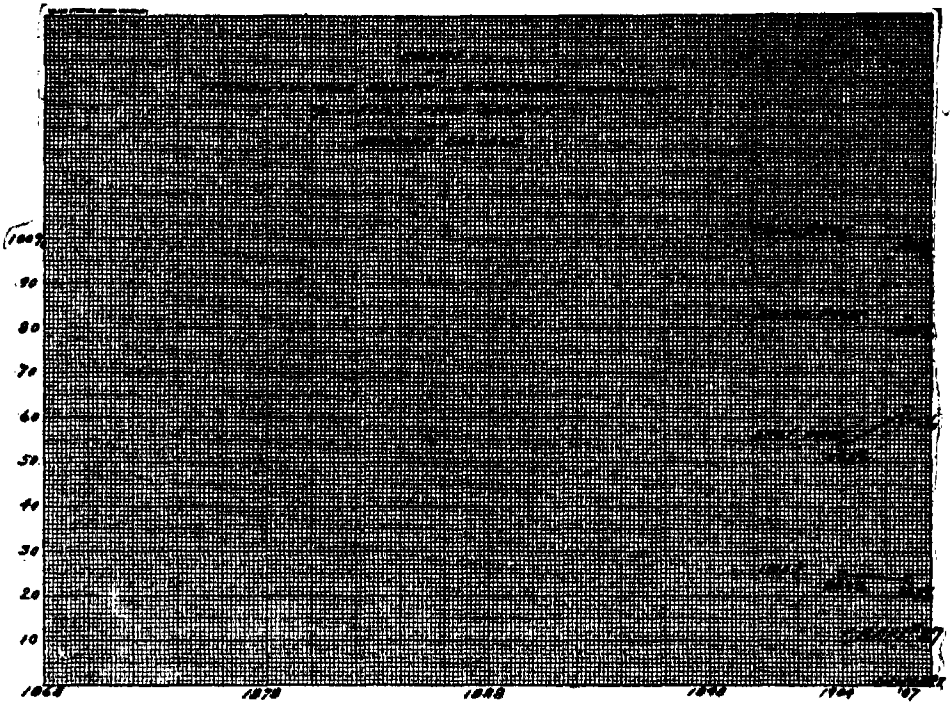


a sabbatical leave. Surely these are short-sighted policies. Let us trust they will soon be abandoned. It is no wonder that after a fair trial of the profession for which they have prepared themselves many of the more spirited men leave it—albeit regretfully—for fields in which they can earn a respectable living, thus creating vacancies to be filled by inexperienced successors. This is the movement, earlier referred to, which seriously threatens efficiency.

Noting Charts 22–26, it is seen that the full professorship must be excepted from the downward trend of the past twenty years. In that rank—and that rank only—the average salary has increased. The effect of this, however, has been to widen the gap between the full professors and the rest of the staff. The remedy which has been proposed by some writers—notably President Pritchett—of bettering the general situation by offering a few capital lottery prizes in the professorial rank is far from reaching the root of the trouble. It does not touch the facts really disclosed by a careful diagnosis of the data. In truth, the effect of such a policy will inevitably be to make the actual situation worse for the great mass of teachers. This becomes clear from a study of charts 27–31.



And this is no small factor in the problem. It may be claimed that relative equity is of more importance than almost any other item touching compensation. Bearing in mind what has been said about age and preparation, do the conditions justify these great differences? It must be borne in mind that a university is not akin to a large factory or business organization in which the various classes of employees are separated by wide social gaps—each one moving in his own circle. On the contrary, by taste, training, ability and aspiration we belong to one compact



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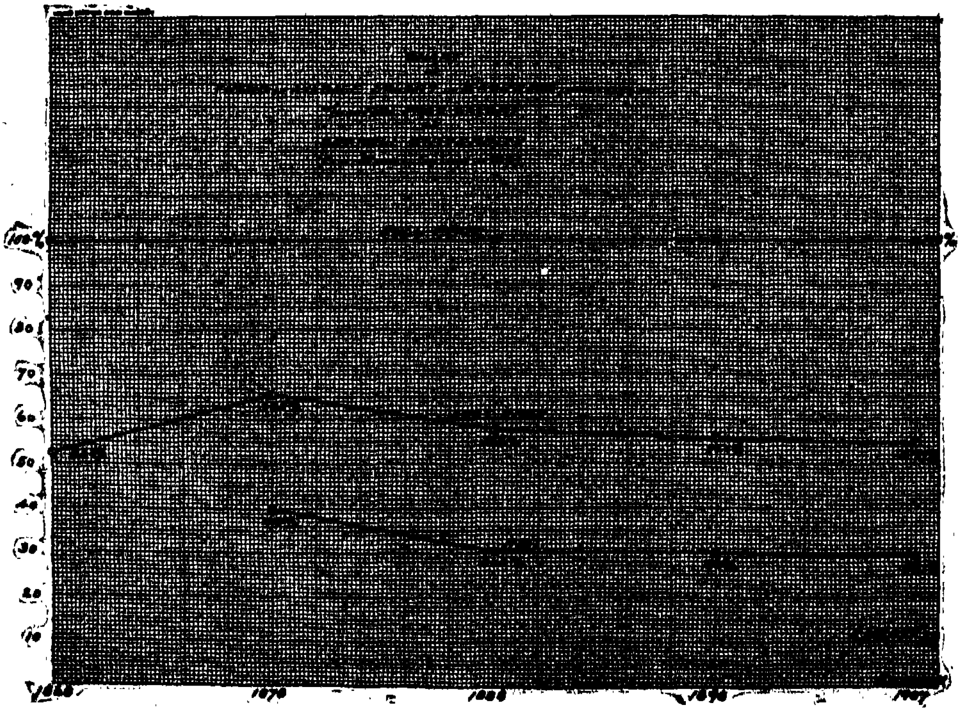

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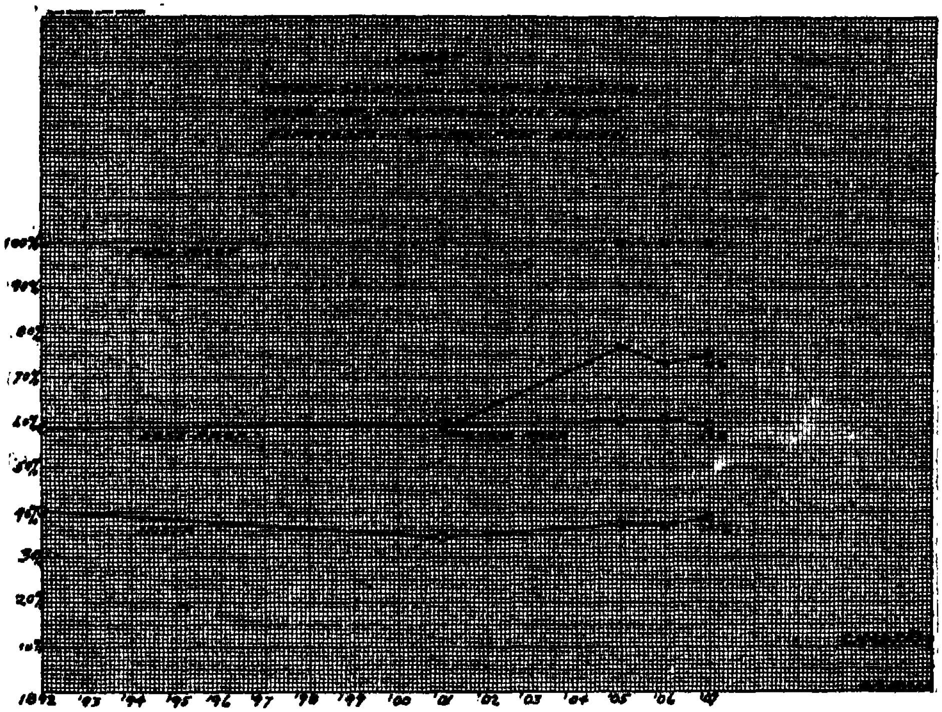
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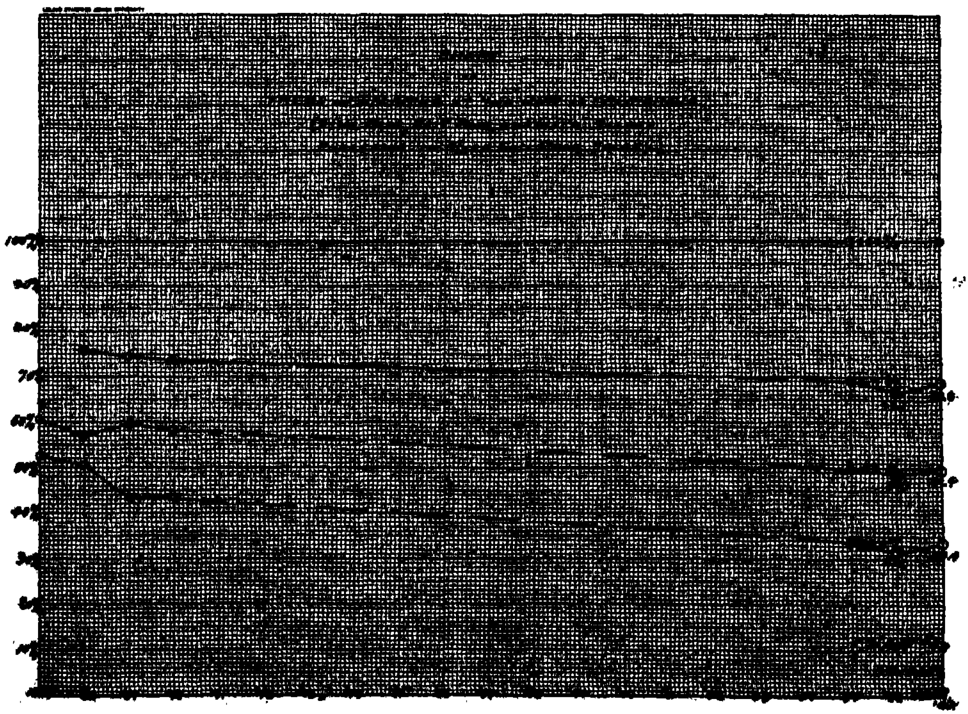
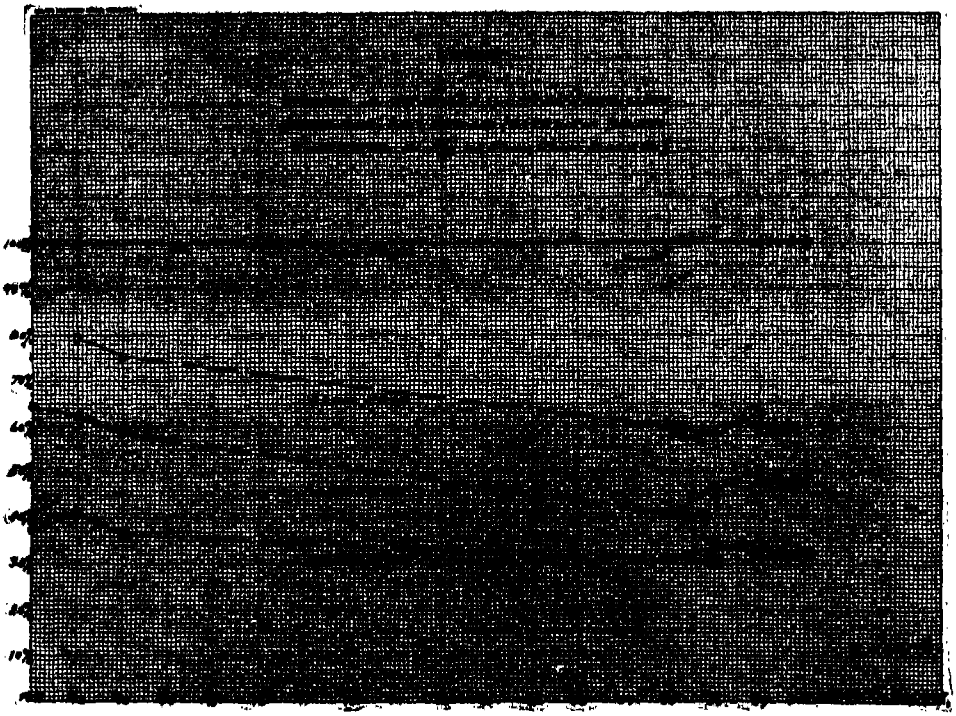


class—and the reciprocal demand between society and ourselves is far more a question of our age and corresponding family responsibilities than one of relative rank in our institution. As has been said, to the man on the street we are all "professor." Careful observation for a number of years leads the writer gravely to doubt the differences in value of men to institutions which these averages indicate. It is his judgment that the sifting process which has gone on from the lower grade schools, through the high schools, colleges and universities, results in the final selection of a few men of very nearly similar gifts and training for recruits to the profession; their further growth and development are largely a matter of opportunity rather than anything else. Here, as elsewhere, "to him that hath shall be given" rules supreme. Fortunate is he who is early able to get sufficiently in advance of his financial obligations to keep in touch with what the leaders in his field are doing by attending their meetings and joining the associations for mutual improvement and advancement of knowledge; to indulge himself in the prompt purchase of books, periodicals and in the satisfaction of other intellectual needs. The most heart-breaking sight in our university communities is to watch the hopeless struggle in which men of brilliancy and promise, gripped by economic factors beyond their control, as in a vise which prevents their growth and development, suffer final narrowing and embittering defeat. It is a tremendous waste of expensively trained material.



The scale of salaries should justly be fixed in accord with the cost of living in the community in which an institution is located. But contrary to general belief—and on this subject the writer has in his

possession interesting and valuable data —the cost of maintaining the *same standard* of living is very slightly different throughout our whole country. The difference comes in mainly as a question of the allowable or *prevailing standard.* The wife of a professor in a prairie state "land grant" college, let us say, may quite properly come to her husband's assistance by increasing the family exchequer through keeping chickens; the wife of a professor in New York City, from equally laudable motives, and without danger of incurring unfavorable criticism, may deplete the exchequer by giving elaborate dinners toward a similar end—but were either to adopt the method of the other she would at once be made to feel the impropriety of her course. It is even conceivable that each might think she would like to try the other plan for a change. The situation grows too complex for us to follow further. *De gustibus non disputandum*—and so we will leave this question of absolute standards.

Returning, however, to the matter of relative standards, it is fair to query, is it not possible to establish a relatively equitable standard as between the various ranks? We find Harvard paying her instructors 23.7 per cent. of what her full professors average. Cornell pays 29.1 per cent.; Stanford, 29.5 per cent.; California, 33.4 per cent. and Wisconsin, 38.5 per cent. There is a difference of opinion here of 50 per cent. as to the relative value of these men. Which is right?

Again, as to assistant professors: Stanford gives them 45.8 per cent. of the full professor's compensation; California, 49.4 per cent.; Cornell, 54.7 per cent.; Wisconsin, 59 per cent. and Harvard, 61.6 per cent. Here is a difference of opinion of 33.3 per cent. Which is right?

As to associate professors we have: Stanford, 63.4 per cent.; California, 68.8 per cent.; Wisconsin, 75 per cent. and Harvard, 81.6 per cent.—a difference of 30 per cent. Again, which is right?

Surely there should be some closer agreement than this on so definite a question.

Similar differences of opinion are very evident elsewhere in fundamental questions of administration. The student of these problems who has struggled with the difficulties of obtaining dependable information hails with delight the valuable material already gathered and published by the Carnegie Foundation. The wholesome publicity and chance for comparison thus given will lead to vital educational reforms and greatly improved efficiency of the entire higher educational system in America.

The following table based upon statistics published by the Carnegie Foundation in Bulletin No. 2 shows the nature of some of the queries which may be raised.

What is a proper proportion of total annual income to be expended for salaries for instruction? Is it 37 per cent., as Missouri makes it at one end, or twice that, as Columbia, New York University, Pennsylvania and Princeton seem to agree?

Recalling charts 13–17; should there be one full professor to forty students, as in Harvard College, or one to twice that number of students, as at California?

Looking at our table again. Considering the entire staff, is Johns Hopkins right with one member of staff for 3.7 students, or are Chicago, Nebraska, Ohio, Syracuse, etc., correct with four or five times as great a ratio as this? A difference of opinion of 500 per cent. is considerable.

Or again, can efficient instruction be provided at an entire expenditure per student year of $97 or $98, as Syracuse and New York Universities have it, or should one expend $456 or $479, as do Harvard

TABLE IV

	Annual Income	Annual Sal. App. for Inst.	Ratio $\frac{\text{Sal.}}{\text{Inc.}}$	Total Students	Total Inst. Staff	Ratio $\frac{\text{Stud.}}{\text{Inst.}}$	Income per Stud.	Sal. Exp. per Stud.	Salary per Member Inst. Staff
Columbia	$1,675,000	$1,145,000	0.683	4,087	559	7.3	$409	$280	$2,050
Harvard	1,827,789	841,970	0.462	4,012	573	7	456	210	1,470
Chicago	1,304,000	699,000	0.535	5,070	291	17.4	257	138	2,400
Michigan	1,078,000	536,000	0.498	4,282	285	15	252	125	1,880
Yale	1,088,921	524,577	0.483	3,306	365	9	529	159	1,440
Cornell	1,082,513	510,931	0.472	3,635	507	7.1	298	140	1,007
Illinois	1,200,000	491,675	0.410	3,605	414	8.7	333	136	1,183
Wisconsin	998,634	489,810	0.491	3,116	297	10.4	321	157	1,650
Pennsylvania	589,226	433,311	0.735	3,700	375	9.8	158	117	1,186
California	844,000	408,000	0.484	2,987	350	8.5	282	137	1,180
Stanford[13]	850,000	365,000	0.428	1,668	146	10.7	510	219	2,500
Toronto	610,000	324,000	0.532	3,498	368	9.5	179	93	881
Princeton	442,231	308,650	0.699	1,301	158	8.2	340	237	1,950
Mass. Institute	505,000	301,000	0.595	1,415	211	6.7	359	213	1,427
Minnesota	515,000	263,000	0.510	3,889	303	12.8	133	68	867
Ohio State	475,000	244,000	0.513	2,014	127	15.8	236	121	1,923
Nebraska	425,000	240,000	0.565	2,886	173	16.6	147	83	1,387
Missouri	655,000	239,110	0.372	2,070	144	14.3	317	115	1,660
McGill	425,000	225,000	0.518	1,163	191	6	365	194	1,176
N. Y. Univ.	303,500	220,000	0.725	3,110	211	14.7	98	71	1,043
Northwestern	491,132	218,151	0.445	2,485	261	9.5	198	88	835
Johns Hopkins	311,870	211,013	0.675	651	172	3.7	479	325	1,226
Syracuse	279,000	180,000	0.645	2,875	199	15.3	97	63	904
Temple C.	72,895	54,272	0.745	2,343	198	11.8	31	23	274

and Johns Hopkins?[14] Again there is a difference of opinion of 500 per cent.

Or, looking at the expenditure per student per year for instructional salaries; which are right, Syracuse and Minnesota at $63 and $68 or Columbia and Johns Hopkins at $280 and $325, respectively?[15] Again 500 per cent. difference.

In fact, the only uniformity appears to be in the difference of 500 per cent. Surely, our institutions can not vary as much as these figures seem to indicate—or do they?

Coming to the last column of our table, obtained by dividing the instructional salary expenditure reported, by the reported number of members of the staff, is an average salary of $274 per year, as given by Temple College (by the way, what is Temple College?) about right? Are Northwestern, Minnesota, Toronto, Syracuse, Cornell right at $835, $867, $881, $904 or $1,007, respectively? Or are Columbia and Chicago, at $2,050 and $2,400, more near a proper standard?

It is such inquiries as these which are inevitably raised by the interesting and valuable data given in the reports of the Carnegie Foundation. And along this line of interesting and valuable data should be included the following table from the annual report of the treasurer of Yale University.

We are just at the beginning of making a real study of the economics of our higher

[13] Data for Stanford appear to need modification. $365,000 includes appropriation for administration, library and instructional staffs, 1907–8. Annual register gives 1,751 students and 218 staff, 1907–8. Excluding assistants, average salary $2,367; including assistants (as above), about $1,500.

[14] The figure of $510 for Stanford includes extraordinary rebuilding expenses as well as sinking fund.

[15] In the *Transactions of the Commonwealth Club of California*, October, 1907, Assistant Treasurer Crothers, of Stanford, gives the instructional salary expenditure per student, 1907–8, as $176.51.

TABLE V

Expenditure and Receipts per Student in Various Departments of Yale University, for the Year 1907–8[38]

Department	No. of Students	Exp. per Stud.	Rec. per Stud.	Ratio $\frac{\text{Rec.}}{\text{Exp.}}$
Graduate	357	$159.45	$ 40.17	25.2 per cent.
Academic	1315	339.56	152.27	44.8 per cent.
Shef. Scien.	948	279.66	160.25	57.3 per cent.
Theology	80	641.03		
Law	339	177.14	122.86	69.3 per cent.
Medicine	137	396.90	130.22	32.9 per cent.
Art	39	315.02	69.25	21.9 per cent.
Music	83	268.99	140.12	52.1 per cent.
Forestry	61	469.39	119.17	25.3 per cent.
All Departments	3359	296.85	113.25	44.9 per cent.

educational system. As a matter of mutual aid, as well as good faith, all chartered institutions should publish a complete annual financial statement.

And now, to sum up this survey, which has necessarily but touched upon main issues.

What are the conclusions to be drawn?

Considering the vast and growing army of students and the marvelous broadening of the field of study which is offered, the impossibility of the ideal of a university "where any person can find instruction in any study," unless it can command unlimited endowments, becomes sadly apparent. For, if it depends at all upon tuition fees and attempts to raise these to the actual cost of the yearly instruction, it will destroy the first part of its democratic ideal—some worthy persons will inevitably be excluded by the expense.

In the writer's judgment it can best fight off the evil day of financial or educational insolvency by frankly limiting its field. The term insolvency is used advisedly—for any institution which can only run by cashing in the loyalty of its employees through lamentably underpaying them, is no less than financially insolvent. And any institution which pretends to and advertises educational resources which it does not possess is educationally bankrupt.

The trend is strong in the direction of limitation of field. Throughout the land we see a clearer and cleaner conception of the difference in nature between the college and university. For pedagogic, disciplinary and economic reasons this distinction is growing more and more marked and in obedience to them institutions are shaping their activities. The greatest educational reform going on in America to-day is involved in viewing our educational system, from the primary schools up, as a whole organism, each division having its distinct part to play, in regard both to its direct relation to the world at large and to its relation to the other parts. To arrive at the evident demand of the world at large with reference to higher education we may consider these facts: in 1905–6 with a population of 83,935,399 in the United States there were 279,270 students receiving higher instruction; the total number of degrees granted was 20,655, which included *1,386* masters of arts and *327* doctors of philosophy. Standing out most impressively we have the fact that a very small number of institutions of genuine graduate rank would suffice to fill the present needs of the nation. And it is precisely this work which is most expen-

[38] Report of the Treasurer of Yale University for the year ending June 30, 1908.

sive and in pursuit of which we find our institutions engaged in an undignified rivalry with vast expenditures caused by unnecessary duplications of staffs and plants. This is a waste to be stopped. We are dissipating our means and energies and in this the professors are their own worst enemies. Taking the liberty of quoting from a letter from President Eliot to the writer,[17] touching upon this point we find:

> There can be no doubt that the increase in university salaries has not kept pace with increased cost of living during the last fifteen years. At Harvard—and I believe at other American universities—the failure to make the rise of salaries keep pace with the rise in the cost of living has been due in part to the natural desire to increase the teaching staff in proportion to the increasing number of students, and also to the keen demand for an increased provision of costly apparatus for teaching, particularly in the sciences. At Harvard I have seen with great regret a large increase in the expenditures for all sorts of objects which are not for direct teaching, though in themselves useful and desirable. The scale of living for colleges as well as for families has distinctly increased of late years, and the adoption of this new scale has interfered with the adequate raising of teachers' salaries.

Although President Eliot here lays stress on costly scientific apparatus, it must be borne in mind that in a recent report he took his faculty to task for extravagant book lists for the library—delicately calling attention to the fact that the need for many of the books called for could not be so very urgent, since it took a considerable portion of the time of the library staff to eliminate from these order lists the names of volumes already in the library. And it would not be out of place to recall here certain figures from the tables previously quoted from the reports of the treasurer of Yale University showing that in the order of cost of instruction the departments stand—theology, forestry, medicine, academic, art and then Sheffield Scientific; the cost per student year in the latter being $17.19 less than the average of all departments. We may sum up, that we are all equally offenders in extravagant and ostentatious expenditures.

Coming back to the lesson to be taught from the statistics of degrees granted in 1905–6, coupled with the waste involved in unnecessary duplication, we can foresee that the next great step in educational reform will be along the line of limitation of field, particularly in the differentiation of the college from the university.

The great demand of the nation to-day is for collegiate training—a great deal better teaching of fundamentals with a view toward developing character and capacity. And ninety-nine one-hundredths of our present institutions could well limit themselves to this field with vast improvement in our educational efficiency. One important reform which this step would bring with it would be a new recognition of the almost forgotten fact that the prime function of the teacher is to teach—thus leading to adequate recognition and reward of teaching ability and devotion to the students' good—rather than discrediting this type of loyal service as is now the case.

There is already a strong trend toward a limitation of function by the institutions to those courses in which they can afford to give thorough instruction, supplementing each other rather than unnecessarily overlapping. A few institutions of ample endowment may be able to carry on for some years longer the combined function of university and college, but in these we shall find a sharper and sharper division-line drawn between the college and university work, with a marked difference in the handling of the students,

[17] In comment on advance sheets of some of the charts of this paper.

both pedagogic and disciplinary. Still fewer, with the men, means and reputation, say half a dozen in our whole country at first, will bravely lop off all collegiate work as soon as it is adequately provided for elsewhere and stand forth as full-fledged *universities*—places for the purposes of true advanced education, for real (not sham) investigation, and for the training of leaders in thought, science and action. Our nation does not yet seem to make a strong demand for many of these, judging by recent experience. What will probably take place, along with more efficient instruction, will be to make the break between collegiate and university work at the end of the present sophomore year as the Germans practically do. There are sound reasons for doing this both from educational and from administrative standpoints, and to these may be added the strong economic argument that it will place our young men and women—quite as well trained as our present college graduates—in the world of outside activities two years earlier in their lives.

As to salaries, with these reforms carried out, there can be no doubt of a continuation of the present trend toward improvement with a hope of an ultimate scale permitting a standard of living within the line of suitable dignity and comfort. The writer would again draw attention to the fact, overlooked too long, that the instructorship is the real key to the situation of the improvement in higher instructional efficiency, and that any fundamental improvement in conditions must be begun in the treatment of this rank. In disclosing the real state of affairs and in guiding the institutions toward a closer cooperation, and unification into an efficient whole, the reports of President Pritchett, of the Carnegie Foundation, have already proved to be of extreme value. Further reports along the lines already indicated will undoubtedly but add to the indebtedness of the educational world to this foundation. With its trained staff and financial support it can carry out investigations which, even with the greatest industry and devotion, would be impossible of achievement through individual effort.

As a final paragraph, the writer would call the attention of his fellow teachers to the inspiring vision of this vast army of young men and women coming forward for training for the duties of life. Well may we conceive a new respect for the importance and significance of our calling, and in all sincerity and humility dedicate ourselves afresh to a life of unselfish service in the cause of humanity; for to our hands is entrusted no less a power than that of effectively molding the controlling ideals of our nation's immediate future. Bacon says:

> We advise all men to think of the true ends of knowledge, and that they endeavor not after it for curiosity, contention or the sake of despising others, nor yet for reputation or power or any such inferior considerations, but solely for the occasions and uses of life.

The great heart of America is sound; her ills of haste, diffusion and superficiality are curable. Humanly speaking, the key to the solution of all her problems lies in the substitution of trained, clear thought-processes for the still too prevalent slovenly-mindedness.

GUIDO H. MARX
STANFORD UNIVERSITY

SCIENTIFIC NOTES AND NEWS

A COMPLIMENTARY dinner was given on April 17 at Hotel Somerset, Boston, in honor of the seventieth birthday of Professor F. W. Putnam, since 1886 professor of American archeology and anthropology at Harvard University and for twenty-five years permanent secretary and later president of the American Association for the Advancement of Science.

A large volume of anthropological essays contributed by various friends and associates was presented, and numerous letters and telegrams of congratulation were received from scientific bodies in this country and in Europe.

We much regret to learn that Professor Simon Newcomb, who had been recovering from an operation performed in January, has been compelled to return to the Johns Hopkins Hospital.

At a convocation of McGill University to be held on the occasion of the opening of McDonald College at St. Anne's on June 3, the degree of LL.D. will be conferred on the Hon. James Wilson, secretary of agriculture; Dr. James Earl Russell, dean of Teachers College, Columbia University; Mr. Gifford Pinchot, chief forester; Dr. D. McEachern, former dean of the faculty of comparative medicine of McGill University, and Dr. James W. Robertson, principal of Macdonald College.

The Cullom Gold medal of the American Geographical Society of New York, awarded to Professor W. M. Davis in the spring of 1908, was presented to him at the meeting of April 20, 1909, when he lectured before the society on the "Lessons of the Colorado Canyon."

Professor A. Lawrence Rotch has recently been elected an honorary member of the Austrian Meteorological Society.

At the Washington meeting of the American Physical Society, Professor Max Planck, of the University of Berlin, now in this country to lecture at Columbia University, was elected an honorary member.

To Professor L. H. Friedburg his colleagues of the chemistry department of the College of the City of New York, gave a dinner on May 1 in celebration of the fortieth anniversary of his receiving the doctor's degree at Göttingen.

Professor Charles B. Richards, for the past twenty-five years head of the mechanical engineering department in the Sheffield School of Yale University, has signified his intention of retiring.

The office of the superintendent for suppressing the gypsy and brown-tail moths by an act of the general court of Massachusetts has been combined with the office of state forester under the title of the latter. Governor Draper and his council appointed Mr. F. W. Rane to the new position on April 14 at a salary of $5,000. The office of state forester has been moved from the State House to No. 6 Beacon street.

Mr. H. Foster Bain has become associate editor of the *Mining and Scientific Press* at San Francisco. Mr. T. A. Rickard, editor of the journal, is about to start a monthly mining magazine at London, England.

Professor Arthur Hoskins, professor of mineralogy in the Colorado School of Mines, was seriously injured by a collision of the train carrying 135 members of the senior class of the School of Mines on a trip of inspection to Utah and Montana.

Professor Wallace C. Sabine, dean of the Graduate School of Applied Science, of Harvard University, sailed from New York on April 29 for Naples. He goes in the interests of the university to observe the equipment and methods of various technical schools in Europe and to study the acoustics of some of the buildings. He will visit technical schools at Turin, Zurich, Aachen, Munich, Leipsic, Charlottenburg, Breslau, Paris, London, Manchester, Leeds and other places.

Dr. Robert Kennedy Duncan, professor of industrial chemistry at the University of Kansas, sailed on May 15 for Europe to attend the International Congress of Applied Chemistry.

Dr. A. Hrdlička, of the U. S. National Museum, has returned from a five months' trip to Egypt and Europe.

Dr. Warren D. Smith has resumed his duties as chief of the Mining Division of the Bureau of Science, Manila, after ten months spent in America and Europe in working up Philippine material. He spent some time in Leiden in comparing Philippine fossils with Dr. Martin's Javan types. While in London Dr. Smith was elected a fellow of the Royal Geographical Society.

Professor J. Mark Baldwin, of the Johns Hopkins University, has been giving courses under the auspices of the Mexican Department of Public Instruction on University

Organization and on Scientific Psychology. According to the *Mexican Daily Record,* in one of his lectures, attended by the minister of public instruction and fine arts, he advocated the union of the professional schools in the City of Mexico and the establishment of a university under the auspices of the government.

Dr. L. A. Bauer gave the following course of lectures on terrestrial magnetism at the Johns Hopkins University, May 4–7: "The Earth's Magnetism and its Variations"; "Solar Activity and Magnetic Storms"; "Magnetic Surveys"; "Methods and Results."

On May 4 Professor Svante Arrhenius began a course of two lectures at the Royal Institution on "Cosmogonical Questions." These are the Tyndall lectures. The Friday evening discourse on May 7 was delivered by Major Ronald Ross, on "The Campaign against Malaria," on May 14 Professor George E. Hale will lecture on "Solar Vortices and Magnetic Fields."

Lieutenant E. H. Shackleton will describe his Antarctic expedition at a meeting of the Royal Geographical Society to be held in the Albert Hall on June 24.

A tablet in memory of the late President Thomas M. Drown has been placed on the walls of the chemical laboratory of the Massachusetts Institute of Technology. A similar tablet will be placed in Drown Memorial Hall of Lehigh University.

The sixtieth congress appropriated, as has been noted here, five thousand dollars for the erection of a suitable memorial to Major J. W. Powell, to be placed on the brink of the Grand Canyon of the Colorado. For the purpose of complying with the will of congress in this behalf, the Secretary of the Interior asked a committee consisting of W. H. Holmes, chairman, H. C. Rizer and C. D. Walcott to assist him in determining the character of the monument and in selecting the site. At the earnest solicitation of numerous old-time associates of Major Powell, this committee has consented to initiate a movement among his friends for the erection of an appropriate monument over his grave at Arlington National Cemetery, which remains as yet unmarked. The character of the monument will not be decided upon until the fund has been raised, but the committee will be glad to receive from contributors suggestions relating thereto. Subscriptions should be sent to Colonel H. C. Rizer, U. S. Geological Survey, Washington, D. C.

The bill to establish a state geological survey in Tennessee has passed both houses of the legislature by a large majority. The bill provides for a commission composed of the governor, secretary of agriculture, state inspector of mines and the heads of the three leading educational institutions of the state, the University of Tennessee, Vanderbilt University and the University of the South (Sewanee). The act carries an appropriation of fifteen thousand dollars for each of the years 1910 and 1911. In view of the unusual expenditures for 1909 the appropriation was not made available until 1910.

For the second time within three months fire threatened with destruction on May 9 the building in Washington in which the Geological Survey is housed. The blaze was extinguished, not, however, until the chemical laboratory had been destroyed and valuable maps and charts stored in the building had been again damaged by water. It is not known how the fire originated, but it is practically certain that crossed electric wires were the cause of the trouble, as they were of the blaze three months ago.

The seventh annual meeting of the Nantucket Maria Mitchell Association was held in Boston on April 28. In addition to routine business, a committee was appointed to collect twenty-five thousand dollars, the income of which shall be used to meet the expenses of an astronomical observer; it is proposed that said fund shall be known as the Memorial Research Fellowship of the Nantucket Maria Mitchell Association and shall provide for the appointee several months study in one of the larger universities, the remaining working months of the year to be given to the Memorial Observatory on Nantucket, where original research work shall be accomplished together

with instructions to classes or individuals. The appointee shall preferably be a woman if equally competent with other applicants, and the fellowship shall be awarded by a committee of six, composed of the president of the association, the chairman of the observatory committee and four others to be named by the president. The committee appointed for this service is Chairman, Professor Mary W. Whitney, Vassar College; Miss Annie J. Cannon, Harvard Observatory; Miss Caroline E. Furness, Ph.D., Vassar College; Mrs. Thomas W. Sidwell, Washington, D. C.; Dr. Emma B. Culbertson, Boston, and Mrs. Charles S. Hinchman, secretary, 3635 Chestnut street, Philadelphia, Pa.

UNIVERSITY AND EDUCATIONAL NEWS

The recent Minnesota legislature appropriated to the State University $2,150,000 for the biennial period. This is in addition to the mill tax amounting to $235,000 annually. Of the appropriation made by the legislature, $190,000 is for support in 1909–10 and $200,000 support for 1910–11. The sum of $350,000 is appropriated for campus extension, and nearly $1,000,000 for new buildings. The latter are to include a general medical building and an anatomical building, each to cost $200,000.

The trustees of Columbia University announce that $500,000 had been secured for the erection of Kent Hall and work on the new law school building will soon begin. Other gifts announced were $30,000 for general university purposes and $5,000 for the department of pathology, both being anonymous.

A fund of $100,000 has been collected for Middlebury College, of which $25,000 has been given by Dr. D. K. Pearson.

Mr. John R. Lindgren has given $25,000 to the Northwestern University to establish a fund for the promotion of peace.

The new hall of engineering of Northwestern University was dedicated on May 7, when addresses were made by Professor John F. Hayford, director of the College of Engineering and Mr. C. W. Baker, editor of *The Engineering News*.

The inauguration of Dr. Abbott Lawrence Lowell, as president of Harvard University, and the attendant ceremonies will be held on October 6 and 7, 1909.

At Columbia University Dr. A. P. Wills, adjunct professor of mechanics, has been appointed professor of mathematical physics, to succeed Professor Richard T. Maclaurin, who will become head of the Massachusetts Institute of Technology. Dr. Bergen Davis has been appointed adjunct professor of physics to fill the vacancy arisen through the death of Professor Tufts. Dr. Geo. B. Pegram has been promoted to an adjunct professorship in the same department. Dr. Hugh Angus Stewart, of Edinburgh and recently of the Johns Hopkins University, has been called to an adjunct professorship of pathology in the College of Physicians and Surgeons.

The new professorship in the department of teaching of the University of Vermont has been filled by the appointment of Dr. J. F. Messenger, A.B. (Kansas), A.M. (Harvard), Ph.D. (Columbia), now professor of pedagogy in the Virginia State Normal School at Farmville.

DISCUSSION AND CORRESPONDENCE

OCCURRENCE OF THE KILLER WHALE (ORCINUS ORCA) ON THE NEW JERSEY COAST

To the Editor of Science: Neither of the two zoologists, Messrs. Rhoads and Stone, who have recently published extensive catalogues of the vertebrate fauna of New Jersey, records any instances of the stranding of killer whales on the coast of that state. Mr. Rhoads remarks of them (1903):

> While often found off the New Jersey coast, there seem to be no records of its stranding, or being captured.

In view of this circumstance, it may be of some interest to note that the National Museum has obtained the skull and other parts of the skeleton of a killer whale which stranded at Barnegat, N. J., in January, 1909. The animal was at first reported to be a strange creature, of a most extraordinary kind, with hair, claws, a long neck, etc., but upon receipt of the skull it was at once seen that these characters were imaginary. The specimen was reported to be about thirty feet

long, and the skull proves it to have been an old individual.

Killer whales rarely strand on the Atlantic coast of the United States, and, aside from the individual just mentioned, there are, so far as I am aware, no specimens from definite localities on our Atlantic seaboard in any museum. Two killers stranded at Eastport, Me., in 1902, and were reported on by myself, and another was obtained at Portland, Me., in 1904, but the bones were not, I believe, preserved in either instance.

F. W. TRUE

April 6, 1909

THE PTARMIGAN AND THE SONNET

TO THE EDITOR OF SCIENCE: Probably some readers of Mr. Clark's letter in SCIENCE, March 26, were no more amused at that queer ptarmigan than at his naming a blank-verse poem a "sonnet." "It is written that the shoe-maker should meddle with his yard and the tailor with his last, the fisher with his pencil and the painter with his nets," to the entertainment of men ever since old Capulet's Peter.

H. L. SEAVER

JOHANNSEN'S DETERMINATION OF ROCK-FORMING MINERALS

SINCE the book review in this journal of January 1, 1909, p. 32, the author has arranged with the publisher to indent and thumb reference the different parts of the text-book. This has added greatly to its convenience and efficiency.

L. McI. L.

FAMILY RECORDS

RECOGNIZING the great importance to humanity of a knowledge of the method of inheritance of physical and mental human characters the Station for Experimental Evolution is attempting to collect data for study and requests the assistance of persons who will volunteer to fill out a pamphlet form with blank spaces for data on some 36 characters in three generations of their family. These "Family Records" are sent in duplicate; one to be retained by the collaborator for his own use, the other to be mailed to the station. A request by postal card for these records will receive an immediate response.

C. B. DAVENPORT

COLD SPRING HARBOR, N. Y.

SCIENTIFIC BOOKS

Handbuch der Klimatologie. Band I. *Allgemeine Klimalehre.* Dritte wesentlich umgearbeitete und vermehrte Auflage. Von Dr. JULIUS HANN. 8vo, pp. xiv + 394, figs. 22. Stuttgart, J. Engelhorn. 1908.

1883, 1897 and 1908 are three important dates in the progress of climatology. They are the years in which were published the first, second and third editions of Hann's "Handbuch der Klimatologie." Few text-books, in any one science, are so widely known to all men of science as Hann's famous "Handbuch." The second edition was so complete and so satisfactory that it was practically impossible to find fault with it in any important respect. Yet the new edition is an improvement upon the former one. The size of the page has been somewhat increased, a fact which is of special significance when the climatological tables, which will be necessary in the second and third volumes, are printed. The arrangement by books, chapters and sections, as well as the many new paragraph headings, help very much to make the volume more convenient for general use. All the important literature bearing dates since the publication of the second edition is mentioned, or summarized, in the new edition. Indeed, this book is much more than a text-book. Its numerous and well-selected bibliographic lists make it truly an encyclopædia.

Additions have been made throughout the volume. We note, especially, the newly introduced or the more extended discussion, of sensible temperatures; of the relative humidity indoors; of the nature and measurements of solar radiation; of the introduction of the cyclonic unit into climatological investigations; of the reduction of temperature observations to uniform periods of time; of the zonal distribution of the climatic elements, and of the classifications of the zones. Many persons will naturally turn to the chapters on

the influence of forests on climate, and on changes of climate, to see what the greatest authority on climatology has to say on these subjects. Regarding the former, Hann says that the influence of forests upon rainfall is a slight one. Regarding the latter, while granting that Stein, Huntington and others have shown that there is a general desiccation going on in Asia, the author adds: "How far in all these accounts we have to do with a progressive desiccation, and how far with climatic oscillations, is still a question." In other words, there is as yet no sufficient evidence for believing in considerable *permanent* changes. Oscillations, yes, some of longer, others of shorter periods; but permanent progressive changes, no, not yet.

The teacher of climatology will feel safe and sure with Hann's book on his study shelf, close at hand. The man of science, in whatever field he may be working, who needs the fullest, latest, most authoritative information on climatology, will find in Hann's new volume what he seeks, and he will find it clearly set forth.

The remaining volumes, dealing with the special climates of the different parts of the world, will be published shortly.

R. DeC. Ward

Reservoirs for Irrigation, Water Power and Domestic Water Supply. By James Dix Schuyler, M.Am.Soc.C.E., M.Inst.C.E., etc. Second edition revised and enlarged. Bound in cloth; dimensions, 6½ by 10½ inches. Pp. 573; illustrations 381; folding plates 6. Price, $6.00. New York, John Wiley and Sons; London, Chapman and Hall, Ltd.

The growing importance of storage reservoirs and their appurtenant structures in the development of domestic water supplies, hydraulic power plants and irrigation projects warrants the revision and enlargement of this already useful work. The scarcity of water furnished by the normal flow of streams for irrigation in the arid regions; the increasing demand for water power due to the decreasing coal supply and the increasing possibilities of electric power and the sanitary needs of the many growing towns and cities throughout the entire country are requiring wide information on the subject of water storage and water-storage structures. This information abounds in the book under review, as may be inferred from its chapter subjects, the titles of which are as follows: Rock-fill Dams; Hydraulic-fill Dams; Masonry Dams; Earthen Dams; Steel Dams; Reinforced Concrete Dams, and Miscellaneous. In these chapters are discussed individually more than 200 important dams, of which the majority are of the masonry type. However, over a score each of rock-fill, hydraulic-fill and earthen dams and nearly a half score of steel and reinforced concrete dams are described in detail.

The style and arrangement of subject matter of the book lack uniformity and its substance is rather a collection of facts relating to dams and reservoirs than a scientific treatise thereof. The author has included but little of the principles of design and construction except as incident to description. The work is therefore better adapted to use for reference than for study. It is an excellent memory storehouse for the practising engineer. Such works, although not forming the highest type of engineering literature, are none the less essential parts thereof, and are especially valuable as sources from which to draw inferences from basic facts.

The first edition of this work found its way into the libraries of many engineers and the second edition is certain to find a still greater circulation. Sufficient new and rewritten material has been incorporated into the text to make the book essentially a new work. In addition to the new and revised subject matter the book contains 234 new cuts and photographs and 3 plates. The work will, therefore, be equally of interest to those familiar and unfamiliar with the first edition.

F. W. Hanna

U. S. Reclamation Service

SCIENTIFIC JOURNALS AND ARTICLES

The American Naturalist for April opens with a paper on "Heredity of Hair Color in Man," by Gertrude C. and Charles C. Davenport. This article includes a number of tables showing the distribution of color in the off-

spring of parents with hair of a given color, the authors concluding that heredity in hair color is alternative, and that the known facts fit Mendel's law rather than Galton's. G. H. Parker discusses "A Mechanism for Organic Correlation," showing the influence of the secretions of various glands in bringing about marked changes in certain portions of the body—these secretions are termed "hormones," and in some instances are absolutely essential to life. Under "Recent Advances in the Study of Vascular Anatomy," John M. Coulter deals with "Vascular Anatomy and the Reproductive Structures." Raymond Pearl presents "A Note on the Degree of Accuracy of the Biometric Constants" and O. F. Cook a communication on "Pure Strains as Artifacts of Breeding."

Bird-Lore for March–April has the following articles: "Chickadee All the Year Round," by Mary C. Dickerson; "A Second Season of Bluebird Tenants," by Marian E. Hubbard; "A Special Bird Blind," by E. J. Sawyer; "Eggs of a Flicker found in a Strange Place" (on the ground), by William Brewster; "Where Does the Male Horned Lark stay at Night?" by R. W. Hagner, and the first paper on "The Migration of Vireos," by W. W. Cook. There is a striking illustration of a drumming ruffed grouse, photographed from life by C. F. Hodge.

IN *The American Museum Journal* for April Charles W. Mead gives some interesting notes of the Andaman Islanders and their customs under "A Collection from the Andaman Islands." W. D. Matthew tells of "The Oldest Land Reptiles of North America" and there is a note, with an illustration of a fine "Group of Peculiar Mollusks," *Vermicularia nigricans*.

The Bulletin of the Charleston Museum for March notes "The Needs of the Museum" in the way of money for the purchase of cases and installation of specimens. The city of Charleston is doing all it possibly can and private individuals must do the rest. In the south, where so large a proportion of the population is negroes, the number of actual taxpayers is vastly less than the number of inhabitants and this is the case in Charleston. The second part of the "Local Fauna" completes the list of birds, 216 species, observed in the vicinity of Charleston.

The Johns Hopkins University Circular for January contains the addresses given at the memorial meeting in honor of Dr. W. K. Brooks and also the charming "Biographical Sketch" by E. A. Andrews, reprinted from SCIENCE. It also contains the addresses commemorative of Dr. Gilman.

THE EPIDERMIS OF AN IGUANODONT DINOSAUR

WE owe to Charles H. Sternberg and his son George F. Sternberg the welcome discovery of the epidermal markings of an Upper Cretaceous Iguanodont. The discovery was made August, 1908, in the region of Converse County, Wyo., made famous by the explorations of Hatcher for remains of Ceratopsia. This Triceratops Zone, originally designated as the Ceratops Zone, is divided, like that of the Hell Creek Basin in Montana, into successive layers of sandstones and clays. The present specimen[1] was found near the summit of the basal sandstones, and is provisionally identified by Mr. Barnum Brown who is making a special study of these dinosaurs, as belonging to the species *Trachodon annectens* Marsh.

As found, the entire animal lay in a normal position on its back and completely encased in the impression of its epidermal covering as far back as the posterior portion of the pelvis and extremities of the hind limbs, which had been cut off and removed by erosion. The left fore limb was outstretched at right angles to the body, while the right fore limb lay stretched over the under surface of the head. The manus is completely encased in the integument, and was thus web-footed—adding another analogy to the Anatidæ. The head was sharply bent around to the right side (the left side as seen from above). The scapulæ were closely pressed to the sides and probably in normal position, as well as the

[1] This unique specimen has been added to the Jesup collection of reptiles and amphibians, through the liberality of Mrs. Morris K. Jesup.

coracoids and sternal plates. The upturned ribs were also without compression, affording a normal section of the chest. The hind limbs were drawn up and doubled on themselves. The animal thus occupied a space of 10×12 feet. The precise position of the elements of the pectoral arch and chest is not the least important feature of the discovery.

The most important feature is the complete encasement of all parts of the body which are preserved in a natural cast of the impression which the epidermis made upon the matrix, affording for the first time complete data as to the skin structure of the Iguanodonts. Some of the outlying parts of the epidermis, especially along the neck frill, at the extremities of the manus, and along certain border regions, were cut into apparently before it was realized that the epidermal cast was preserved; but at many important points these impressions are perfectly shown, especially on the throat and anterior part of the neck, on the arms, and fore limbs, on the entire right side of the body, and over a large part of the ventral surfaces, including the axillary regions and especially over the abdomen. Most remarkable is the inflection of the skin like a curtain along the lower border of the ribs, over the entire abdominal region without a single break, with brilliant impressions of the scale pattern. Equally significant are the sharp skin folds over the sides of the body and in the axillæ, at the throat, and along the flexor surfaces of the arms. This abdominal infolding, the close appression of the skin to the surface of the bones, the sharp transverse folds, all indicate that after death the body had been exposed for a long time to the sun, that the muscles and viscera had become completely dehydrated; in other words, the body had become thoroughly dried and mummified, while the epidermis became hardened and leathery under the action of the sun. In this condition the dinosaur mummy had been caught in a freshet and rapidly buried in fine river sand which took a perfect cast of the epidermal markings before the tissues disintegrated under the solvent action of the water.

The first and most surprising impression is that the epidermis is extremely thin, and that the markings are excessively fine and delicate for an animal of such large dimensions. There is no evidence in any part of the epidermis either of coarse tubercles or of overlapping scales. In all parts of the body observed it is entirely composed of scales of two kinds: (1) larger pavement or non-imbricating scales, (2) smaller tubercular scales.

The former are perfectly smooth and non-imbricating, like the pavement head scales on the Lacertidæ. As grouped in clusters or rosettes they are rounded or irregularly polygonal. Over the throat, neck, sides and ventral surface these clusters are regularly disposed in definite patterns, separated by areas of finer tubercular scales, but in the tail, as indicated in another specimen, it is probable that the cluster arrangement disappears and that the entire tail is covered with the tessellated or pavement pattern, including scales of larger size, although this may be a matter of specific difference. In many existing lizards we observe a strengthening of the scales in the caudal region, and the vigorous use of the tail among Iguanodonts as a balancing and perhaps partly as a swimming organ, would lead us to expect stronger scales in the tail region.

As observed on the sides of the body just above the scapula, the pavement scale clusters are 3.5 to 4.5 cm. in diameter. In the center of the cluster the scales are about .5 cm. in diameter, and toward the borders they diminish to .35 cm., while the outlying tubercular scales number six or seven per centimeter. These clusters run in definitely arranged patterns, which will be fully described in a later communication, from the sides around the under surface of the body.

On the side of the throat in the region just back of the quadrates are much larger clusters of these flattened scales, but beneath the throat there is again observed the alternation of the clusters with intermediate tubercular areas. A large cluster is beautifully preserved on the upper arm, half way between the elbow and shoulder, but the lower arm seems to be chiefly covered with the small tubercular scales, although some pavement scales may also be observed. On the forearm the skin

is thrown into diagonal folds, but seems to preserve some of the muscular contour.

On the tail of another specimen of *Trachodon*, from the American Museum Cope Collection, the entire epidermis is covered with flattened scales of larger size, nearly a centimeter in diameter.

This disposition of the scales into the larger pavement groups and smaller tubercular areas is unlike that observed by the writer in any lacertilian; it appears to be unique. In a second paper the longitudinal and perpendicular arrangement of the clusters will be more fully made out.

Mr. Sternberg has added another of his important contributions to science through the fortunate discovery of this unique specimen, in a geologic region which was very generally considered as thoroughly prospected out.

HENRY FAIRFIELD OSBORN

BOTANICAL NOTES

SHORT NOTES

IN the March number of the *Journal of Botany* R. F. Rand begins his altogether interesting "Wayfaring Notes in Rhodesia" which remind one of the notes made by the traveling botanists of a century or so ago. Here one finds morphological, ecological, taxonomic and critical notes delightfully commingled.

AKIN to the foregoing are the notes on English plants made by Matthew Dodsworth, a seventeenth century botanist, now first published in the *Journal of Botany* for March, by the editor. It is interesting to note such names as "Wild Williams" (for *Lychnis flos-cuculi*) and "Woodbind" (for Woodbine). A couple of letters to Plukenet are dated 1680 and 1681.

IN a recent number of the *Centralblatt für Bakteriologie, Parasitenkunde und Infectionskrankheiten* (Bd. XXII., Abt. 2) Dr. O. Jensen, of Copenhagen, proposes a new classification of the bacteria based upon their activities. He recognizes eleven families, as follows: *Oxydobacteriaceae, Actinomycetes, Thiobacteriaceae, Rhodobacteriaceae, Trichobacteriaceae, Luminobacteriaceae, Reducibacteriaceae, Acidobacteriaceae, Alkalibacteriaceae, Butyribacteriaceae, Putribacteriaceae.* A chart showing the relationship of these families and the genera they contain accompanies this quite suggestive paper.

AN interesting paper on the temperature relations of foliage-leaves in the February number of the *New Phytologist* is likely to be somewhat disconcerting to those botanists who still speak of the "cool leaves"—made so by transpiration. Not only are leaves shown to have a high internal temperature in the sunlight, but Molisch has found that leaves may have a high temperature due to respiration.

ELMER D. MERRILL, of the Biological Laboratory of the Bureau of Science, Manila, has published many important botanical papers during the past two years in the *Philippine Journal of Science*, among which are the following which have been issued as separates: Index to Philippine Botanical Literature; The Flora of Mount Halcon, Mindoro; Additional Identifications of the Species described in Blanco's Flora de Filipinas; Philippine Plants collected by the Wilkes United States Exploring Expedition; New Philippine Plants from the Collection of Mary Strong Clemens; New or Noteworthy Philippine Plants; The Oaks of the Philippines (*Castanopsis*, 1 sp.; *Quercus*, 17 sp.); Philippine Ericaceae (*Rhododendron*, 16 sp.; *Vaccinium*, 19 sp.; *Gaultheria*, 2 sp.; *Diplycosia*, 2 sp.); On a Collection of Plants from the Batanes and Babuyanes Islands.

FROM the Philippine Bureau of Forestry we have the Annual Report of the director, Major George P. Ahern, and a paper by the same author, entitled "A Few Pertinent Facts concerning the Philippine Forests and Needs of the Forest Service, that should interest every Filipino." In the latter he urges the Filipinos to educate their children for the public service, especially as foresters, and calls attention to the 60,000 square miles of public forests and the advantageous position of the islands for the supply of lumber to the far east. In another bulletin (No. 9) W. I. Hutchinson calls attention to a Philippine

substitute for lignum vitae in the heartwood of *Xanthostemon verdugonianus*, which weighs 77 pounds per cubic foot. The tree is large, with a diameter of 45 inches, and a length of stem of 25 to 30 feet. It occurs in the southern islands of the archipelago.

CHARLES E. BESSEY
UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

A FOSSIL GAR-PIKE FROM UTAH

SOME time ago Professor R. D. George obtained in Utah a fine specimen of *Lepisosteus* preserved in a block of limestone. The fossil is of particular interest because the stone is being quarried by the Western Lithographic Stone Company, yielding slabs highly serviceable for lithographic purposes. The age of the formation had not been determined until the fish was examined, but it is now safe to say that it is Middle or Lower Eocene. The specimen was obtained twelve feet from the surface, three miles northwest of Tucker, Utah. It lacks the head, but is otherwise in very good condition. In all respects, it agrees excellently with *Lepisosteus simplex* Leidy, as described and figured by Eastman.[1] Eastman's excellent figure, except for having the head, might almost have been taken from our specimen. The smooth scales, with occasional minute pits, are in exact agreement, as are the characters of the fins, etc.

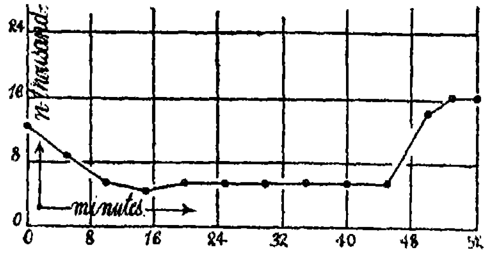
L. simplex was found in the typical Green River locality in Wyoming, according to Eastman, though Hay ascribes it to the Bridger Eocene. There is a species described from Utah, *L. cuneatus* (Cope), which has smooth scales, and it is at least very much like *L. simplex*. This *L. cuneatus* comes from the Manti shales, Manti being some fifty miles south-southwest of Tucker. Eastman (*loc. cit.*) ascribes this to the Miocene, but Cope considered it Eocene, and it has been held that the Manti shales are of the same age as the Green River. It may be that the true Green River extends from Wyoming to central Utah, and that *L. cuneatus* is the same as *L. simplex*.

T. D. A. COCKERELL
UNIVERSITY OF COLORADO

[1] *Bull. Mus. Comp. Zool.*, XXXVI., No. 3.

THE NUCLEATION OF A CLOSE LECTURE ROOM

RECENTLY, at the request of Professor Barus, I made a series of measurements on the nuclei in the air of a crowded lecture room. There were over a hundred students in attendance and the ventilation was not sufficiently brisk to obviate the occurrence of somewhat offensive closeness at the end of the hour. The object of the investigation was to determine whether any solid or liquid nuclei were thrown off by the many lungs in action, sufficient to be detected by the coronas of the fog chamber in the presence of the natural nucleation (largely inorganic) of the lecture room.



The method of investigation consisted in aspirating the air of the room continuously through the fog chamber and examining it by exhaustion from time to time. The result may best be given graphically by laying off the nuclei in thousands per cubic centimeter in a way to show their variation in the lapse of minutes of time.

The figure begins with a moderate measure of dust during the desultory entry of the members of the class. But throughout the lecture hour the nucleation diminishes. Evidently there is subsidence of dust (in part into the lungs of the students who virtually cushion the floor), but no corresponding evolution of nuclei as resulting from the respiration of this animated carpet. At the close of the lecture, when the class rises hilariously as a body to depart from the place of torment, they literally raise the dust again, in much larger quantity than on entering.

Unfortunately it is impossible to separate the organic from the inorganic dust content of this atmosphere for the present purposes. The only conclusion attainable is, therefore, that there is no appreciable evolution of non-gaseous matter, but rather an absorption of nuclei

by the respiration of a hundred active lungs, even when the closeness of the air becomes oppressive. The possibility of recognizing spore production, however minute, from cultures made in dust-free air, may not be without interest.

LAURA C. BRANT

BROWN UNIVERSITY,
PROVIDENCE, R. I.

SOCIETIES AND ACADEMIES

THE AMERICAN MATHEMATICAL SOCIETY

THE one hundred and forty-third regular meeting of the society was held at Columbia University on Saturday, April 24, 1909, extending through a morning and an afternoon session. The attendance was about thirty-five persons, including twenty-six members of the society. President Böcher occupied the chair, being relieved at the afternoon session by Vice-President Kasner. The council announced the election of the following persons to membership in the society: Miss W. B. Bauer, High School, Topeka, Kan.; Mr. W. W. Denton, University of Illinois; Mr. Meyer Gaba, University of Kansas; Professor W. H. Garrett, Baker University; Miss S. E. Graham, High School, Topeka, Kan.; Mr. G. F. Gundelfinger, Sheffield Scientific School; Professor W. A. Harshbarger, Washburn College; Mr. L. T. W. Hogrefe, Milwaukee, Wis.; Professor L. A. Howland, Wesleyan University; Mr. George Melcher, State Normal School, Springfield, Mo. Three applications for membership in the society were received.

Professor H. S. White was reelected a member of the editorial committee of the *Transactions* for a term of three years beginning October 1, 1909.

The following papers were read at this meeting:

R. D. Carmichael: "On certain functional equations."

R. D. Carmichael: "Note on some polynomials related to Legendre's coefficients."

W. H. Jackson: "A theorem concerning simple continued fractions."

W. H. Jackson: "Shadow rails."

L. P. Eisenhart: "The twelve surfaces of Darboux and the transformations of Moutard."

W. F. Osgood: "On Cantor's theorem concerning the coefficients of a convergent trigonometric series, with generalizations."

L. S. Dederick: "Certain singularities of transformations of two real variables."

Paul Saurel: "On Fredholm's equation."

J. E. Wright: "On abelian functions of genus 3."

J. C. Morehead: "A simplification of Lagrange's method for the solution of numerical equations (second paper)."

A. S. Chessin: "On gyroscopic couples."

Edward Kasner: "The interpretation of differential equations in line coordinates."

E. D. Roe, Jr.: "On the extension of the exponential theorem."

Mr. Dederick's paper was presented to the society through Professor Bouton. In the absence of the authors Mr. Dederick's paper was read by Professor Böcher, and the papers of Professors Carmichael, Saurel, Chessin, Kasner and Roe, and Dr. Morehead were read by title.

The Chicago section of the society held its spring meeting at the University of Chicago on Friday and Saturday, April 9-10. The summer meeting and colloquium of the society will be held at Princeton University in the week September 13-18.

F. N. COLE,
Secretary

THE UTAH ACADEMY OF SCIENCES

THE second annual meeting of the Utah Academy of Sciences was held in the auditorium of the Packard Library, Salt Lake City, on Friday evening, April 9, and Saturday afternoon, April 10.

The Friday evening meeting was a "Darwin Centennial" memorial, as indicated by the program:

"Darwin the Man," by Professor W. W. Henderson.

"Factors in Zoological Evolution," by Dr. John Sundwall.

"Factors in Botanical Evolution," by Dr. C. T. Vorhies.

Discussion, led by Dr. E. D. Ball.

The Saturday afternoon program consisted of the following papers:

"The Adaptation of Insects, with Special Reference to Arid Conditions," by Dr. E. D. Ball.

"The Alfalfa Leaf Weevil," by Professor E. G. Titus.

"The Honey Ants of Utah," by A. O. Garrett.

"Orbital Glands of Amphibians," by P. G. Snow.

"Note on Geological Survey Bulletin No. 371," by J. B. Forrester.

"High Temperature Measurement," by Dr. L. W. Hartman.

"Pottery Glaze Coloring," by A. F. Greaves-Walker.

"The Valuation of Fuel according to Analysis," by Dr. William Blum.

"Philippine Birds," by Chaplain Joseph Clemens, Ft. Douglas.

At the business session, the following officers were elected for the ensuing year:

President—Dr. W. C. Ebaugh, University of Utah.

First Vice-President—Dr. E. D. Ball, Utah Experiment Station.

Second Vice-president—W. D. Neal, Weber Stake Academy.

Secretary—A. O. Garrett, Salt Lake High School.

Treasurer—Dr. Philena Fletcher Homer, Brigham Young University.

Councillors—Professor J. L. Gibson, University of Utah, Dr. S. H. Goodwin, Proctor Academy; and Professor W. W. Henderson, Brigham Young College.

A. O. GARRETT,
Secretary

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

THE 433d regular meeting of the society was held April 20, 1909, President Hough in the chair.

The first part of the evening was devoted to a paper on "The Peoples of the Philippines," by Dr. Daniel Folkmar, formerly lieutenant-governor of the province of Bontoc, and consisted principally in the presentation of the results of anthropometric studies of 800 to 1,000 Filipinos in the prison of Bilibid. While the Negritos and other interior tribes were touched upon, Dr. Folkmar confined himself in the main to the Moros and the eight principal Christian peoples—the Tagalogs, Bisayas, Pampangas, Ilocanos, Pangasinans, Cagayans, Zambals and Bicols. The investigations seemed to show a division of the Filipinos into two principal types, exclusive of the Negritos, a southern, or perhaps we should rather say coastal, and a northern or interior type, the Moros, curiously enough, occupying an exact intermediate position. At the same time Dr. Folkmar expressed greater confidence in language as a means of classification in the Philippine group than physical characteristics. He considered that, with the exception of the Negritos, all Philippine tribes were affiliated with the Malayan race and constituted part of the Malay problem. In discussing this paper Dr. Boas stated that the anthropological problems of southeastern Asia were concerned with three races, the Malayan, the Negrito, and a short but light people represented by the Veddahs of Ceylon.

The society then listened to reports of its officers for the past year, and proceeded to the election of officers for 1909 to 1910, which resulted as follows:

President—J. Walter Fewkes.

Vice-president—James Mooney.

Secretary—John R. Swanton.

Treasurer—George C. Maynard.

Additional Members of the Board of Managers—I. M. Casanowicz, J. N. B. Hewitt, F. W. Hodge, C. H. Robinson, Mrs. M. P. Seaman.

JOHN R. SWANTON,
Secretary

THE AMERICAN CHEMICAL SOCIETY. NEW YORK SECTION

THE seventh regular meeting of the session of 1908–9 was held at the Chemists' Club on April 9.

The following papers were presented:

"The Municipal Explosives Commission of New York," by A. A. Breneman.

"Note on the Nitration of Triphenylmethane," by R. Schwartz.

"The Volumetric Determination of Cerium," by F. J. Metzger.

"Does Thorium exist as Silicate in Monazite?" by O. Kress and F. J. Metzger.

"The Reversal of the Photographic Image," by Wilder D. Bancroft.

Owing to the interference of the dates of the American Electrochemical Society meeting and the Congress of Applied Chemistry, there will be but one more meeting this season, to be held May 14.

C. M. JOYCE,
Secretary

THE TORREY BOTANICAL CLUB

THE meeting of April 13 was held at the American Museum of Natural History at 8:30 P.M. and was called to order by Mr. Charles Louis Pollard, who presided in the absence of the president and both vice-presidents.

Mr. Norman Taylor, chairman of the field committee, asked that authority be given him to issue a circular letter requesting the members to vote relative to the continuance of the field meetings. The club voted that this authority be given.

The announced paper of the evening on "Botanizing on the Headwaters of the Saskatchewan and Athabasca Rivers" was then presented by Mr. Stewardson Brown. The lecture was illustrated by lantern slides.

PERCY WILSON,
Secretary

SCIENCE

Friday, May 21, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of Science, Garrison-on-Hudson, N. Y.

THE PHYSICAL BASIS OF LIFE[1]

It is frequently stated that the cell is the unit of life, and this is a convenient form of expression, but its exact truth depends upon the conception that one has of life. The cell may be regarded as the morphological unit of life, but form in and of itself, and as recognized by the eye, is not essential to the manifestations of life. We know no life apart from matter, and matter and energy are the only things that we do know. When matter becomes endowed with life, it does not cease to be matter; it does not lose its inherent properties; it is not released from the laws that determine its structure, its attractions and its motions. In studying the organized cell of living things, whether vegetable or animal, whether bone or brain, it should always be borne in mind that it is material in composition, subject to the fundamental laws that govern matter, and possessed of the properties essential to matter.

The only essential, characteristic and constant difference between living and non-living matter is that within the former there is constant and rhythmic metabolism, while in the latter no such process occurs. The living cell is made up of active, labile molecules and these molecules consist of numerous atoms, and each atom contains a large group of electrons; atoms and electrons are in ceaseless, rhythmic motion, while groups of atoms are being constantly cast out of the molecule and replaced by new groups split off from matter outside the molecule. Metabolism, the one char-

[1] Address of the president before the Association of American Physicians, Washington, May 11, 1909.

acteristic phenomenon of living matter, involves intramolecular change; consequently the molecule, and not the cell, is the unit of life. Matter is endowed with life when it becomes the seat of that form of energy which makes of it a metabolic mechanism. As soon as a molecule becomes the seat of assimilation and excretion it is no longer dead; it lives. As a result of assimilation, it acquires the property of building up its own substance; then polymerization follows and reproduction in its simplest form begins. The one phenomenon always manifested by living matter and never exhibited by non-living matter is metabolism. Verworn says:

> Vital motion, metabolism, is a complex motion very strongly characterizing the living organism; it consists in the continued self-decomposition of living substance, the giving off to the outside of the decomposition products, and in return, the taking on from the outside of certain substances which give to the organism the material with which to regenerate itself and grow by the formation of similar groups of atoms, *i. e.*, by polymerization. This is characteristic of all living substance.

Aristotle apparently recognized that metabolism is the one characteristic of living matter, for he said:

> Life is the assemblage of the operations of nutrition, growth and destruction.

The Greek philosopher and scientist did not know all that is now known about cells, molecules, atoms and electrons, but we must admit that he had a fairly clear conception of the most essential characteristic of living matter.

Du Bois Raymond said that the matter in crystals and non-living substances is in a condition of indifferent static equilibrium, while that in living bodies manifests a motile equilibrium. Bechterew says that we know of nothing in the inorganic world that contains or consists of motile compounds.

Matter is alive when it feeds and excretes. Crystals grow, and in a sense they multiply, but their growth is not intramolecular; it is by accretion. The living molecule not only absorbs; it assimilates. It chemically alters what it receives. The atomic groups taken into living molecules enter into new combination. The living molecule is not stable; it is highly labile. Its composition is never constant; it is never in a condition of equilibrium. There is a constant reaction between the living molecule and other molecules. This reaction consists in the absorption and assimilation of certain atomic groups and the casting out of others. Apart from other matter it could not exist.

What is accomplished by this constant interchange of atomic groups between the living molecule and outside matter? It is for the purpose of supplying the living molecule with energy. Allen expresses this fact as follows:

> The most prominent and perhaps most fundamental phenomenon of life is what may be described as the energy *traffic*, or the *function of trading in energy*. The chief physical function of living matter seems to consist in absorbing energy, storing it in a higher potential state, and afterwards partially expending it in the kinetic or active form. We find in living matter a peculiar proneness to change its composition under the stimulus of slight changes in the energy-equilibrium between itself and its surroundings, energy being readily absorbed and readily dispersed. The absorption of energy coincides with deoxidation and the building up of large molecules. The building up of these large molecules is always accomplished by slow steps; but when formed, the said molecules are very unstable, irritable or, in modern phrase, *labile*. They may be broken down by degrees in some instances; in others their structure may be so precarious as to collapse on the slightest disturbance.
>
> The lability of such a molecule may be compared to that of a house of cards, which can be taken to pieces card by card, or may collapse at once. But the word lability is applied not only to destructive, but also to constructive instability. The molecules of living substance are prone to constructive as well as destructive changes; but as in the house of cards the constructive changes

are the most gradual; and as the structure grows more complex, construction becomes more difficult, and collapse is more imminent. It should be distinctly understood, however, that it is not the mere size of the molecules that makes them labile, but rather the manner in which they are linked together and the amount of potential energy which is included in the molecule.

It is probable that in the absorption of energy by the living molecule, oxygen is released from combination with carbon or hydrogen, and is attached to nitrogen, while in the liberation of energy the inverse takes place. Nitrogen and phosphorus, sometimes with iron and manganese, seem to be, as it were, the master elements within the living molecule. It is by virtue of their chemism that groups are detached from extracellular matter, taken into the living molecule, and assimilated by an atomic rearrangement; and, furthermore, it is on account of the lability of the compound thus formed that potential energy is converted into kinetic and all work is accomplished.

Life is function and not form, and moreover it is a molecular function. The cell is made up of many and possibly of diverse molecules, but it is the function of the intracellular molecules that determines the nature of its activities. The following quotation from Nussbaum, as given by Loeb, shows that the biologist recognizes that the cell is not the unit of life.

The cell is not the ultimate physiologic unit of life, even though it must remain such for the morphologist. We are, however, not able to tell how far the divisibility of a cell goes, and how we can determine the limit theoretically. Yet, for the present, it will be well not to apply to living matter the conceptions of atoms and molecules which are well defined in physical chemistry. The notion, Micella, introduced by Naegele, might also lead to difficulties, as the properties of living matter are based upon both nuclein and protoplasm. The cell consequently represents a multiple of individuals.

Pflüger has shown that the egg, which has been thought to be a biologic unit, can give rise to many individuals, and Loeb states that his own experiments, as well as those of Driesch, confirm this finding.

In his interesting monograph on the "Biogen Hypothesis," Verworn objects to saying that a molecule lives. He states that this is illogical.

A living thing is only that which demonstrates the phenomenon of life—something that changes itself. A molecule of a given compound, so long as it remains unchanged, can not be said to be living.

Then, in order not to speak of living molecules, he introduces the term "biogen molecule." Surely, this is a distinction without a difference. I agree with the distinguished German physiologist that a molecule of a cell, so long as it remains unchanged, can not be said to be living, but the point is that living molecules do not remain unchanged. When life is latent, as it is in spores, seeds and ova, the molecule can not be said to be alive, neither are the cells alive; but when placed under favorable conditions, the change between atomic groups in the molecule and the extracellular food substance begins, and life manifests itself. A seed contains the germinative cell, a specific ferment and the stored food. The seed is not alive; it possesses only latent life. So long as it remains merely a seed the ferment has no action on the stored food, but place it under suitable conditions of temperature and moisture and the ferment begins to break down the stored protein, and as a result of the chemical cleavage induced by the ferment, relatively simple nitrogenous bodies, such as the mono-amino acids, tyrosin and leucin, and the diamino bodies, arginin and lysin, are formed. These substances begin to react with the molecules within the germinative cell, and latent life is quickened into the active form; the mechanism begins to

work and growth commences. Many of the lower forms of life can not feed upon the proteins. This is true of the yeast cell. These cells grow rapidly when placed in a solution of sugar and nitrates, but proteins must be broken up by putrefactive bacteria before yeast organisms can feed upon them. Indeed, many of the cells in the body of man can not feed upon the complex proteins, which must be split up into simpler groups by the digestive enzymes before the cell molecules can absorb and assimilate them. Even the carbohydrate starch must be hydrated and its elements rearranged as the constituents of a more labile molecule before it can become a source of energy in muscle. Solutions of proteins injected into the blood of man are poisonous, but the same substances, after being properly split up, are valuable sources of energy, and some are essential to the continuance of those functions that constitute life.

The atomic groups cast out from the living molecule are not altogether waste products, for among them are the specific secretions which act upon the extramolecular substance, and fit it for absorption and assimilation. Many of these substances have a reversible action. The colon bacillus will feed at one time on solutions of highly complex proteins, the secretion splitting up the large molecule into smaller groups, thus acting as an analytical agent. The same bacillus will grow in a medium that contains available nitrogen only in the form of amino-acids, its secretion acting as a synthetical agent and building up complex bodies out of simpler ones. It is by means of the specific secretion that the living cell, or the molecules of which it is composed, feeds, or, in other words, breaks up the pabulum placed within its reach into groups suitable for absorption or assimilation. In case of fixed cells the food stuff must be brought to the cell or within close range of it before it can be prepared for assimilation. Life in a cell molecule ceases when food is withdrawn, or when the secretion is wanting, or from any cause made inactive. No living molecule can continue to function when new material is wanting. Each living, acting molecule has a selective action in the assimilation of new material, and this is quite indicative of metabolism being a chemical or intramolecular process. It might be supposed that a living molecule is a highly complex body, possibly with many basic and many acid groups. In the process of metabolism an acid group is cast out and this enters into one of the molecules of the foodstuff, setting free another acid group which takes the place of the group cast out. In this way the living molecule feeds, regenerates itself, and supplies itself not only with new matter but with energy. These movements are rhythmical and continue in the same tempo so long as conditions remain the same. It may be that groups of different sizes are cast out and replaced from time to time, smaller groups being thrown off more, and larger ones less, frequently. We have reason for believing that in many living molecules there are at least two kinds of metabolism which occur simultaneously, but in different tempo. The more frequent consists in casting out from the living molecule relatively small groups consisting largely of oxidation forms of carbon and hydrogen. The less frequent is a nitrogenous metabolism in which urea or some antecedent of this substance is eliminated and is replaced by fresh material. It is possible that individual molecules are broken up beyond repair in the nitrogenous metabolism, the worn-out one having already reproduced its successor by polymerization. The tempo with which these processes of metabolism occur may be altered by changing the external conditions. When the speed is too

great or when it is too slow continued metabolism, or life, may be endangered. The tempo is altered when it becomes necessary for the living matter to do work. More energy must be absorbed, the greater the work done, and this needed increase in energy can be secured only by increasing the speed with which the metabolic process takes place.

I wish to call attention to the fact that in even the simplest unicellular organism its normal processes are purposeful. The cell molecules attract substances that serve them best as foods. From these they select the parts that they can utilize, and reject the parts that can not serve them. This is true, however, only within certain limits, because often they do absorb substances that lead to their own destruction. Their selection seems to be guided by chemism, which on the whole leads them in the safe way, but may cause their destruction.

It is not my purpose to discuss at this time the question of the relation between the existence of a nervous system and conscious action or psychical activity, but I do wish to call attention to the fact that low forms of life in which there is no trace of nerve tissue behave in a purposeful manner. Many of the low forms of life in which there is no trace of the development of the sense of sight, or sound or feeling, are responsive to light, to sound and to stimulation. We see most convincing evidence of this in the phenomena of helio-, thermo-, chemio- and galvano-tropism. Under the influence of optical, thermic, chemic and electric stimuli these low forms of life, devoid of any trace of nervous system, manifest movements that serve them in self-protection, in securing food and in reproduction. These lower forms of life without nerve tissue apparently learn by experience to choose between what is good and what is bad for them. Metalnikov placed carmin in a fluid in which ciliated infusoria were swimming. At first they absorbed the carmin granules, but having done so once, they could not be induced to try this food again. This behavior, it must be admitted, is much the same as that of the dog which, having been struck with a stick once, runs away when he again meets the same man with a stick. Certain infusoria that feed upon bacteria select the species upon which they feed. The movements of infusoria in pursuit of their prey are certainly purposeful, if not conscious. The readiness with which low forms of life accommodate themselves to altered environment shows that they are capable of being trained or educated to a certain extent. Stahl has shown that a certain plasmodium flees when sprinkled with salt, but if the salt be added to the medium gradually the organism accommodates itself to the new medium. Purposeful action is manifested by plants as well as by animals, and by both unicellular and multicellular plants. This is in evidence in the movements of algæ and moulds. Leaves turn toward the sources of light and heat, and the roots seek nourishment in the earth. The capability of responding to certain stimuli is common to all cell life, whether it be vegetable or animal.

In multicellular animals, such as man, we have colonies, or groups of cells, or organs, bound together. Each kind of cell has its own peculiar molecular composition and through these living molecules the work of the organ is accomplished. A framework of bone, cartilage and connective tissue support and hold in position these organs. They are supplied with food material by a common system of blood and lymph vessels, and their harmonious action is secured through the nervous system. The digestive organs roughly prepare the food for all, but each has its own secretion

which shapes the pabulum for intramolecular assimilation. This is accomplished in both instances by means of specific ferments that are formed within the cell molecules. These enzymes bring about changes in the pabulum at the relatively low temperature of the body which can be wrought by inorganic chemicals only at much higher temperature and after prolonged action.

The cell molecules in each organ of the higher animals have their own peculiar composition and manifest their own peculiar function. The chemical composition of the liver differs from that of every other organ in the body. The liver cell molecules cast out their own characteristic products and absorb and assimilate special atomic groups. Moreover, the tempo of metabolism probably differs in each organ, or at least the cell molecules of each organ have their own optimum tempo to which their metabolic processes conform. The more complicated the structure of the cell molecule, the more energy may be stored in it, the greater its lability and the greater is its susceptibility to altered conditions. In the nervous system the molecular structure is the most complex, the amount of stored energy is at the maximum, and the readiness with which this energy may be released is most manifest. In the active central nervous system, or the brain, we have the highest manifestation of the molecular functions that characterize life. The molecules that make up this structure are most susceptible to alteration in conditions. In their function they are influenced by slight disturbances in other organs. We have heard much of late concerning the influence of mind upon the body, and many who speak upon this subject seem to assume that there is some entity, called mind, that controls the body to which it is superior, and apart from which it may exist. This dualistic doctrine is as old as the philosophy of Plato; it always has been and remains to-day a dogma without scientific support, and as a hypothesis it has led to the discovery of no scientific fact. Every attempt to apply it to the treatment of disease has led to the development of conscious or unconscious charlatanism, and has resulted in more or less marked atavism. The term functional disease is now being used by those who know but little concerning the functions of the body in either normal or abnormal states. It seems to be inferred or assumed by those using this expression that a mysterious power has been given to some to set the mechanism of the disordered body aright, although those supposed to be possessed of this gift have no knowledge of, or but imperfect and superficial acquaintance with, the functions of the various organs and their interrelations. In truth we have no evidence of the existence of a functional disease as thus understood. In health the several organs of the body function harmoniously; in disease there is lack of perfect harmony, and we know of no disease in which this condition does not exist. We may not always be able to find where the basic fault lies, but shall we for this reason stop looking for it, shut our eyes, give over our search and ask some individual, quite ignorant of the body and its functions, to undertake the task of inducing harmonious activities? Of mind apart from the body we know nothing. Of the brain as one of the correlated organs we know something, and by continued and patient research we hope to learn much more. We do know that the cell molecules of the brain are the most complex, the most highly labile and the most susceptible to external influences of any of the structures that constitute that community of organs which makes up the individual. We know that the introduction of such poisons as alcohol, morphine and cannabis indica

into the blood, leads to disorder of cerebral function; that failure to function properly on the part of the liver, kidney, spleen or other organ, modifies the activity of the brain; and that, on the other hand, altered function in the brain may disturb the functions of these other organs. The medical profession is fully aware of the fact that man thinks not only with his brain, but in a certain sense with every organ in his body. In other words, we know that the perfection of activity of the brain is modified and determined by the proper and healthy activity of other organs of the body, although we are ready to admit that our knowledge along this line is by no means complete. We have studied in myxedema the effect of disordered function in the thyroid upon the central activity. We have learned that in chronic malaria, the central activities, the ideals and the philosophy not only of the individual but of nations, may be debased; that in uncinariasis and other forms of parasitism like results may follow. In short, medical observation and study have shown that healthy cerebral function is to be found only when the activity of the brain is properly influenced by normal function of all the correlated organs. We know equally well the influence of the brain on the other organs of the body. We are fully aware of the fact that impulses may be started in the brain through any of the five senses that may favorably or unfavorably influence the activities of correlated organs, and for centuries the medical profession has employed this physiological principle in the treatment of disease. Savory dishes, pleasingly garnished, through the sense of sight and smell tempt the appetite and stimulate the flow of the digestive juices. Cheerful surroundings aid digestion. Cheering words improve the circulation, and hope is often the best tonic that the physician can administer. As I have stated, the medical profession has understood and has utilized these physiological facts for centuries, and there is nothing in them to justify the founding of any new cult. That the brain of one individual may be modified in its activity by the sounds that fall from the lips of another is as much of a physical fact as that of the contraction of a muscle by the passing of an electric current through its nerve. There is nothing in this to justify a dualistic doctrine involving the existence of mind apart from and superior to matter. Indeed, every step in the process is in accord with the laws of physics and chemistry. The vocal organs of the speaker set in motion the sound waves that strike upon the ear of the hearer, the auditory nerves carry the impulse to the brain center, and the brain molecules respond. There is nothing in it that the most materialistic of philosophers might not endorse. Sensibility, or the capability of responding to stimuli, is, as Claude Bernard said, to a certain extent the starting-point of life; it is a primary phenomenon and from it all others, physiological, intellectual and moral, develop. Bechterew holds that irritability or sensibility is due to a motile cohesion in the biomolecule, and that psychical activity is the result of a complex function of this molecule. Since nothing comes from nothing, the basis of psychical action must lie in the physico-chemical elements of the organism.

Victor C. Vaughan
University of Michigan

ETHNOLOGICAL EVIDENCE THAT THE CALIFORNIA CAVE SKELETONS ARE NOT RECENT

Since the discovery of the celebrated Calaveras skull, many human skulls and skeletons have been found in caves along the west slope of the middle Sierra.[1] The presence of human

[1] See Sinclair, *Univ. Calif. Pubs.*, Am. Arch. and Eth., Vol. 7, No. 2, 1908.

remains in these caves has been interpreted to mean that the Indians now living in the region practise cave burial, or did practise it until recent times. This is an error. The Indians of this region, the Mewuk, burned their dead, and never under any circumstances put them in caves. These Indians believe the caves to be inhabited by a stone giant, whom they call Chehalumche, who sallies forth at night in search of food. He preys, by preference, on people, but when he can not get people, takes deer or other animals. He never eats his victims in the open but carries them into the caves and there devours them. Members of several subtribes of the Mewuk have told me this, and have looked with horror on the suggestion that they or their ancestors might ever have put their dead in caves. They say: "Would you put your mother, or your wife, or your child, or any one you love, in a cave to be eaten by a horrible giant?" The idea is so abhorrent to them that the theory of cave burial must be abandoned as preposterous. The Mewuk feel that the finding of human bones in these caves must convince us of the truth of their belief in the occupancy of the caves by Chehalumche, the bones being those of the victims he has carried there.

The mythology of the Mewuk does not admit of any migration but describes the creation of the people in the area they still inhabit. This, in connection with the fact that these Indians speak a language wholly different from any known in any other part of the world, proves that the Mewuk have occupied the lands they now occupy for a very long period—a period which in my judgment should be measured by thousands of years.

This argues a great antiquity for the cave remains, for they must be those of a people who inhabited the region before the Mewuk came—and this takes us back a very long way into the past.

C. Hart Merriam

FRU SIGNE RINK

We regret to announce the death, April 19, in Kristiania, Norway, of Fru Signe Rink, widow of the late H. Rink, formerly Danish governor of Greenland and supervisor of the Greenland commerce; and known all over the world for his valuable contributions to the ethnology of the natives of Greenland and the Eskimo people generally. Fru Rink survived her husband many years, and was the author of several little books and other writings on the tales, home life and traditions of a people with whom she had a partial connection by blood. Probably no one in Europe had a more intimate knowledge of their character, though it was with difficulty she could be persuaded to the publicity of authorship. Personally she was of a most kindly, hospitable and vivacious disposition, and her death will leave sorrow in many hearts. A daughter resident in Kristiania survives her.

W. H. Dall

EXHIBIT OF THE BUREAU OF EDUCATION AT THE ALASKA-YUKON-PACIFIC EXPOSITION

The plans of the National Bureau of Education for an exhibit at the Alaska-Yukon Exposition have been formed with special reference to the interests of teachers and officers of education.

In the section assigned to the bureau in the government building, a conference room has been fitted up where visiting educators will find ready welcome. Here they may consult publications pertaining to current movements in education, and a select reference library for teachers. The classified catalogue of this library will be furnished upon request. Arrangements for professional conferences in this room at stated hours may be made if desired.

The space surrounding the conference room is given up to exhibits pertaining to movements for the uplift and extension of rural education. These exhibits illustrate what is actually being done for the improvement of rural schools in the more progressive communities, and thus by concrete examples suggest the means of meeting needs which are felt in every part of the country. The separate exhibits have been prepared under the direction of a committee of the bureau appointed by the Commissioner of Education, assisted by expert collaborators in different sections of the country.

Special interest attaches to exhibits presenting typical courses of instruction in art, in nature study and in geography, prepared by authorities in these respective branches who are also masters of the art of graphic presentation.

Manual training, as carried out in the rural high schools, which are rapidly increasing in number, is well represented in the section. The importance of this training is emphasized by a typical course of manual training exercises equally adapted to city and country high schools, arranged for this occasion by Dr. Calvin M. Woodward.

The absorbing interest in this country at the present time in the development of high schools in which provision is made for agriculture, domestic science and manual arts, is emphasized in the exhibit by material pertaining to these subjects as parts of the school curriculum. This material consists of monographs, leaflets and photographs by means of which every phase of this comparatively recent departure in our educational provision is illustrated.

The equipment of rural schools is vastly increased by traveling and loan museums of which important examples have been supplied to this exhibit from the National Department of Agriculture, and from the chief scientific museums of the country which are rapidly coming into the same relation with the common schools as the traveling libraries.

The entire exhibit is arranged around two centers, as it were, namely, the model of an improved type of rural school, and a graphic presentation of the consolidated rural school. This plan emphasizes the fact that the first condition of improvement in common schools is their suitable housing.

The different collections in the exhibit are all fully labeled, and credit is given in each case to the source from which the particular exhibit was derived.

It is hoped that all teachers and school officers visiting the exposition will avail themselves of the opportunity thus afforded by the National Bureau for the study of salient educational problems of the hour, and also for professional meetings and conferences.

Special appointments for the conference room, and documents intended for circulation may be secured by addressing Mr. James C. Boykin, acting representative of the Interior Department at the Alaska-Yukon Exposition.

DELEGATES TO THE DARWIN CELEBRATION AT CAMBRIDGE

THE following is the list of American institutions which have been invited to send delegates to the celebration to be held in Cambridge next month in honor of the Darwin centenary and of the delegates who have been appointed:

Ann Arbor, University of Michigan, Dr. H. S. Carhart.

Baltimore, Johns Hopkins University, Dr. J. M. Baldwin.

Berkeley, University of California, Dr. Jacques Loeb.

Boston, *American Academy of Arts and Sciences, Professor W. Gibson Farlow.

*Boston Society of Natural History, Professor C. S. Minot.

Cambridge, Harvard University, Dr. A. Agassiz and Dr. Theobald Smith.

Charlottesville, University of Virginia,

Chicago, University of Chicago, Professor J. M. Coulter.

Evanston, Northwestern University,

Cold Spring Harbor, Station for Experimental Evolution, Dr. C. B. Davenport.

Columbus, Ohio State University,

Indiana, *Franklin Literary Society,

Ithaca, Cornell University, President J. G. Schurman.

Madison, University of Wisconsin, Dr. F. B. Powers.

Minneapolis, University of Minnesota, Professor E. van Dyke Robinson.

New Haven, Yale University, Professor R. H. Chittenden.

Connecticut Academy of Arts and Sciences, Professor Tracey Peck.

Peabody Museum of Natural History, Professor R. H. Chittenden.

New York, Columbia University, Dr. E. B. Wilson.

New York University, Dr. H. M. Biggs.

*New York Academy of Sciences, President C. F. Cox.

American Museum of Natural History, Director H. C. Bumpus.

Palo Alto, Stanford University, Professor V. L. Kellogg.

Philadelphia, University of Pennsylvania, Dr. C. C. Harrison.

*Academy of Natural Sciences, Dr. A. E. Brown.

*American Philosophical Society, Professor H. F. Osborn.

Pittsburg, Carnegie Institute, Dr. Samuel Harden Church.

Princeton, Princeton University, Professor W. B. Scott and Professor W. O. Richardson.

San Francisco, *California Academy of Sciences, Dr. G. E. Hale.

St. Louis, Washington University,

Washington, Smithsonian Institution, Dr. C. D. Walcott.

Carnegie Institution, Dr. R. S. Woodward.

Academy of Sciences, Dr. L. O. Howard.

U. S. Geological Survey,

The George Washington University,

Department of Agriculture,

Woods Hole, Marine Biological Laboratory, Dr. E. B. Wilson.

* Societies of which Charles Darwin was an honorary member.

AMERICAN CHEMICAL SOCIETY

THE summer meeting of the American Chemical Society will be held in Detroit, Mich., June 29 to July 2, and there is every prospect that the meeting will be one of the most largely attended and successful in the society's history. The local society of Detroit chemists is putting forth every effort to insure a successful gathering. One day of the meeting will be spent in Ann Arbor as the guests of the University of Michigan.

The council of the society will meet on June 28 and the opening session of the general meeting will be on the morning of June 29 in the Central High School which offers every facility for the meeting of the various divisions and sections of the society.

The Hotel Pontchartrain has been selected as headquarters for the meeting.

Titles of papers to be read at the summer meeting should be sent to the secretary of the society or to the secretaries of divisions and to find place on the program should reach me on or before June 7. Papers for the section of chemical education should be sent to the chairman, H. P. Talbot, Institute of Technology, Boston, Mass., before June 5.

A full program of the meeting will be sent to all members of the society about June 20.

CHARLES L. PARSONS,
Secretary

DURHAM, N. H.

SCIENTIFIC NOTES AND NEWS

AT the last meeting of the American Academy of Arts and Sciences, it was voted to award the Rumford premium to Professor Robert W. Wood, of the Johns Hopkins University, for his discoveries in light and particularly for his researches on the optical properties of sodium and other metallic vapors.

At the last meeting of the Rumford committee of the American Academy the following grants were made: To Professor M. A. Rosanoff, of Clark University, for his research on the fractional distillation of binary mixtures, $300; to Professor C. E. Mendenhall, of the University of Wisconsin, for his research on the free expansion of gases, $300.

PROFESSOR F. W. PUTNAM has been elected honorary member of the Societa Italiana d'Anthropologia, Ethnologia e Psicologia Comparata of Florence, Italy. Since 1887 he has been a corresponding member of this society.

DALHOUSIE UNIVERSITY has given its doctorate of laws to Dr. A. Ross Hill, president of the University of Missouri, who graduated from Dalhousie in 1892.

PROFESSOR R. MELDOLA, F.R.S., has been elected a member of the Athenæum Club for scientific eminence.

THE Marine Biological Station of San Diego having developed to such an extent as to require the entire time of the scientific director; and having been so endowed as to make it possible for him to devote himself to it, the present director, Professor Wm. E. Ritter, will relinquish the active headship of the department of zoology in the University of California at the close of the present academic year and will take up his permanent residence at the station. After June 1 his address will be, therefore, La Jolla, California.

DR. E. E. SOUTHARD has been appointed pathologist to the Massachusetts Board of Insanity, from May 1, 1909. The position is a new one in Massachusetts. The appointee will be required "to visit the different institutions from time to time as the representative of the board, with particular reference to the supervision of clinical, pathological and research work, and, so far as possible, in an advisory capacity, to stimulate interest, coordinate efforts and promote the best results in this direction."

PROFESSOR E. T. ROBBINS, assistant animal husbandman, Iowa Experiment Station, has accepted a position on the editorial staff of the *Breeders' Gazette*, Chicago, Ill.

A GEODETIC survey department for Canada has been established under Dr. W. F. King, chief astronomer of the dominion.

DR. HEINRICH RIES, professor of economic geology at Cornell University, has been commissioned by the Canadian government to make a survey of the clay deposits of Canada.

THE University of Pennsylvania has granted leave of absence until October 1, 1910, to Philip P. Calvert, Ph.D., assistant professor of zoology, to enable him to go to Central America to pursue further researches on the ecology of tropical Odonata. This is in continuation of the studies which have grown out of his preparation of the account of these insects for the *Biologia Centrali-Americana*. Dr. and Mrs. Calvert sailed from New York on April 17 for Costa Rico.

DR. CARL LUMHOLTZ has gone to the arid regions of Sonora and the upper part of Lower California to make ethnological research among the Pina, Papago and Cocopa Indians. He will also study the physical geography of the little-known region between Rio de Altar and the mouth of the Colorado River. Dr. Lumholtz will be gone until next winter, returning in February or March.

DR. RAYMOND F. BACON, of the chemical division of the Bureau of Science, Manila, is spending five months in this country.

PROFESSOR VON RUNKER, director of the Agricultural Institute of Breslau, Germany, and Professor Erich Tschermakedeer von Seysenegg, of the College of Agriculture, Vienna, Austria, have been sent by their governments to study agricultural experiment stations in the United States.

PROFESSOR CHARLES BASKERVILLE, director of the chemical laboratory, College of the City of New York, sailed for London on May 15 on the steamer *Kroonland*, to attend the Seventh International Congress of Applied Chemistry. He will be abroad all summer.

DR. MAX MEYER, professor of experimental psychology in the University of Missouri, will leave toward the end of May for a year's stay in Europe on leave of absence.

DR. A. LAWRENCE LOWELL, president-elect of Harvard University, will give the Phi Beta Kappa address at Columbia University on June 1, at 4:30 in the afternoon. The subject will be "Competition in College."

PROFESSOR RAYMOND DODGE gave an illustrated lecture on "The Nature and Practical Importance of Fatigue," before the Middletown Scientific Association on May 11.

PROFESSOR ROBERT FLETCHER, of the Thayer School of Civil Engineering at Dartmouth College, will give the memorial address at the Rose Polytechnic Institute of Terre Haute, Ind., on June 8. The occasion is the graduation of the twenty-fifth class, and the commemoration of founders day.

PROFESSOR JOHN C. OSTRUP, of Stevens Institute of Technology, delivered an address before the Canadian Society of Civil Engineers at Montreal, Canada, on the evening of May 6. The subject was "Some Features of the Design and the Construction of the Manhattan Suspension Bridge." The address was illustrated with lantern slides and brought out a spirited and interesting discussion.

AN anonymous benefactor has expressed his willingness to contribute a sum of £500, or so much of this sum as may be required, to supplement the £500 which the senate has voted towards defraying the cost of the Darwin commemoration at Cambridge.

DR. F. G. YEO, F.R.S., emeritus professor of physiology in King's College, London, has died at sixty-four years of age.

The late Mr. W. H. Hudleston, the eminent geologist, has left his unrivaled collection of types of Oolitic Gasteropoda to the Sedgwick Museum, Cambridge, and £1,000 to the Geological Society.

The University of Colorado has received an interesting collection of fishes from the river Nile, presented by the Egyptian government through Dr. Boulenger, of the British Museum.

We learn from *Nature* that at a special general meeting of the Zoological Society on April 29, it was decided to dispose of the site of the society's freehold premises in Hanover Square, and to expend the proceeds upon the erection of new offices, library and meeting-room at the Zoological Gardens in Regent's Park, and on the general improvement of the gardens.

It is expected that the Marine Laboratory of the Johns Hopkins University will be re-opened in Jamaica in 1910, so that graduate students and instructors will have the opportunity to study marine and mountain flora and fauna in the tropics and to obtain material for research problems.

On May 8 the Theta Chapter of Alpha Chi Sigma, the national chemical fraternity, was installed at the University of Nebraska by Dr. J. H. Mathews, of the University of Wisconsin, and Mr. L. S. Palmer, of the University of Missouri. The following men constitute the new chapter: Professor Benton Dales (director), Professor George Borrowman, Jr., P. B. Barker, O. L. Barneby, H. J. Broderson, M. R. Daughters, C. J. Frankforter, R. L. George, L. F. Gieseker, W. L. Hadlock, F. C. Hawks, W. D. Jensen, S. A. Mahood, G. R. McDole, W. H. Warren, A. L. Weaver and E. F. Wilson. Alpha Chi Sigma is a professional chemical fraternity, organized in 1902, with the purpose of promoting a fraternal spirit among chemists, of providing a reward for faithful undergraduate work and of providing a closer relationship between alumni and students. It now has chapters at the University of Wisconsin, University of Minnesota, Case School of Applied Science, University of Missouri, University of Indiana, University of Illinois, University of Colorado and University of Nebraska. A chapter will shortly be installed at the Rose Polytechnic Institute.

The annual dinner of the Syracuse Chapter of Sigma Xi was held at the St. Cloud Hotel on May 13. Research reports were called for as follows: department of astronomy, Professor H. A. Peck; chemistry, Professor E. N. Potter, zoology, Professor C. H. Richardson; mathematics, Professor W. H. Metzler; botany, Professor W. L. Bray. Professor E. N. Pattee was elected president; Dr. H. D. Senior, vice-president; Professor C. H. Richardson, secretary, and Professor F. F. Decker, treasurer. Mr. E. C. Keenan and Mr. N. E. Loomis were elected to membership as graduate students.

The fourth meeting of the Research Workers in Experimental Biology of Washington was held at the Medical School of George Washington University on May 1. Dr. Oswald Schreiner, of the Bureau of Soils, spoke on "Some Factors of Soil Fertility." The lecturer laid special emphasis upon the influence of organic matter of the soil with reference to the biochemical relationships which exist between soil and crop and the microorganisms within the soil. The influence of organic compounds isolated from the soil on plant growth was illustrated by lantern slides and photo-micrographs of the crystalline materials were also shown. The lecture was followed by discussion.

Mr. Henry P. Phipps was formally presented on May 12 with the gold medal awarded him by the International Anti-Tuberculosis Association for his aid in waging war against consumption. The presentation was made by Dr. Lawrence F. Flick, at a dinner tendered at the Bellevue-Stratford in Philadelphia. Mayor Reyburn presided and the speakers were introduced by former Ambassador Tower. Mr. R. W. DeForest, president of the New York Charity Organization Society, responded to the toast "Henry Phipps, Citizen of New York," Hon. H. D. Harlan, chief judge of the supreme bench, spoke on "Henry Phipps, benefactor, of Baltimore." Dr. William J.

Holland, director of the Carnegie Museum, spoke on behalf of Pittsburgh and Dr. Talcott Williams, on "Henry Phipps, a native of Philadelphia."

LORD AVEBURY took the chair at the annual *conversazione* of the Selborne Society on May 7. Two lectures were given, the first on "How Birds Fly," by Mr. F. W. Headley, F.Z.S., science master at Haileybury College, and the second on "How Men Fly," by Mr. T. W. K. Clarke, A.M.I.C.E., the first engineer to build aeroplanes in Great Britain. Mr. James Buckland exhibited a number of lantern slides illustrating the birds that are in danger of extermination in various parts of the world. There was also a display of microscopes and natural history exhibits.

THE seventy-seventh annual meeting of the British Medical Association will be held in Belfast on July 23–31. The president-elect is Sir William Whitla, professor of materia medica and therapeutics, Queen's College, Belfast. The address in medicine will be delivered by Dr. R. W. Philip, that in surgery by Professor A. E. J. Barker, and that in obstetrics by Sir John W. Byers. The popular lecture will be delivered by Dr. J. A. Macdonald.

NEWS has been received from Dr. Charcot's Antarctic expedition which has arrived at Deception Island, one of the South Shetland group, on December 22. The *Pourquoi-Pas* left the island on Christmas day for Port Lockroy, from which it was to proceed to the south. Dr. Charcot hopes to establish his winter quarters on Alexander Land, the name given to the region lying to the south of Graham Land in about 70° south latitude, which will form a point of departure either for exploring the coast line towards King Edward VII. Land or for penetrating into the interior. No further news may be expected from Dr. Charcot for at least a year.

A NATIONAL conference on criminal law and criminology in celebration of the fiftieth anniversary of the founding of the Northwestern University School of Law will be held in the Northwestern University building, Chicago, on June 7 and 8.

THE annual meeting of the Naples Table Association for Promoting Scientific Research by Women was held on April 24 by invitation of Director Bumpus, at the American Museum of Natural History. Miss Caroline McGill, of the University of Missouri, was appointed a scholar of the association at the Naples Station. The award of the prize of one thousand dollars offered every second year for the best thesis written by a woman on a scientific subject, embodying new observations and new conclusions based on an independent laboratory research in biological, chemical or physical science, was made to Miss Florence Buchanan, D.Sc., of London University, fellow of University College, London, for a thesis entitled "The Time taken in the Transmission of Reflex Impulses in the Spinal Cord of the Frog." Of the eleven theses presented in competition five were sent from England and one from Canada. The subjects of four were morphological, of two bacteriological, of two zoological, one physiological, one was in parasitology and one in physical chemistry.

THE seventh Congress of the International Institute of Sociology will meet in Bern, from July 20 to 24 next at the invitation of the Swiss government. The sessions will be held in the university and under its auspices. Senator Baron R. Garofale, of Venice, will preside, and the subject of social solidarity will be discussed from a variety of wholly scientific points of view. Representatives of many countries, including the United States, will be in attendance. It will be remembered that the last congress was held in July, 1906, at the University of London, under the presidency of the eminent French economist, M. Levasseur, when the opposite question of social struggles was exhaustively canvassed.

THE International Congress of Psychology will hold its sixth meeting in Geneva this year from August 3–7, under the Presidency of Professor Thomas Flournoy. The program, as noted in the *British Medical Journal*, includes discussion of general and special topics, questions of standardization, demon-

stration of apparatus, and individual papers. The general topics to be discussed are feelings (by Külpe and Sollier), subconsciousness (Dessoir, Janet, Prince), measure of attention (Patrizi, Ziehen), religious psychology (Höffding, Leuba). The special topics are the psychopedagogical classification of backward pupils (Decroly, Ferrari, Heller, Witmer), pedagogical psychology (Ioteyko), orientation at a distance (Thauziès), perception of position and movement of the body and limbs (Bourdon). Under standardization will be included terminology, standard colors, enumeration of errors in testimony experiments, notation of age of children, mathematical determination of numerical results of experiments. Communications relative to the congress should be addressed to the general secretary, Professor Ed. Claparède, 11, Avenue de Champel, Geneva.

THE skeleton of the fine male *okapi* presented to the Natural History Museum some time since by Major Powell-Cotton has, we learn from the London *Times*, been articulated and put out in the east corridor. The attitude corresponds with that of the mounted skin, for which the museum is indebted to the same donor, the head and neck being nearly in a line with the back. When the *okapi* was described it was believed that the neck was partly raised, and this idea was embodied in mounting the skin of the female presented by Sir H. H. Johnston. It has since been found that the head and neck are stretched forwards. In addition to the two mounted specimens mentioned, the museum has a third, obtained by the Alexander-Gosling expedition, and presented by Mr. Boyd Alexander. This possesses the small bare tips to the horns, which are not developed in Major Powell-Cotton's specimen. In one of the cases of the geological gallery casts of the skull of the *okapi* have been put out by the side of the skull of the extinct *Samotherium*, its nearest ally, for comparison. So close is the resemblance between these two forms that in the official guide to the extinct mammals and birds one species of *Samotherium* is referred to as "an extinct *okapi*."

UNIVERSITY AND EDUCATIONAL NEWS

THE recent New York legislature passed the bill providing that the governor of the state shall appoint five members of the board of trustees of Cornell University. The bill to establish at Cornell a state school of sanitary science and public health was not passed. For the general support of the State College of Agriculture, Cornell University, the legislature has appropriated $175,000, an increase over last year of $25,000.

PROFESSOR WILLIAM NICHOL, of Kingston, has given to Queen's University, Kingston, Ont., a building for mining and metallurgy, and the Ontario government has appropriated $100,000 for a chemistry building.

AT the recent McGill University convocation it was announced that $60,000 had been guaranteed by the committee, which intends to establish a chair in memory of the late Dr. Harrington, professor of chemistry. About $20,000 has already been subscribed and a committee of four has agreed to be responsible for the remaining $40,000.

THE Sanders chemical laboratory at Vassar College was dedicated on May 15, when brief addresses were made by the donor, Dr. Henry M. Sanders, of New York; President Taylor, and Professor Charles W. Moulton, head of the department of chemistry.

DR. BOYD H. BODE, assistant professor of philosophy in the University of Wisconsin, has been appointed professor of philosophy in the University of Illinois.

AT Williams College, Dr. F. L. Griffin has been appointed assistant Professor of mathematics; Dr. Brainerd Mears, instructor in chemistry and Dr. J. M. Warbeke, instructor in philosophy.

MR. J. K. ROBERTSON, of Toronto University, has been appointed lecturer in physics at Queens University.

MR. WALTER K. VAN HAAGEN, B.S., assistant in chemistry, Lehigh University, has been elected associate professor of chemistry in the University of Georgia.

PROFESSOR ERNST LECHER, of Prague, has been called to the chair of experimental physics in Vienna.

DISCUSSION AND CORRESPONDENCE

GENERA WITHOUT SPECIES

IN response to the suggestion made in SCIENCE of February 26, p. 340, I have received a number of communications, in substance as follows:

I agree throughout with your opinions as expressed in SCIENCE for February 26; . . . I hold a genus is not established unless a type species is named.—J. C. Arthur, Purdue University. (Fungi.)

I entirely agree with you that generic names published without any mention of included species are to be regarded as invalid. It seems to me that a genus can not possibly be constituted without reference to a species.—C. J. S. Bethune, Ontario Agricultural College. (Entomology.)

1. A genus is an aggregation of one or more species. The type of a genus is, must be, an included species, that is, an originally included one. Therefore if there are no species at all how is it possible to have a genus? Genera without species are certainly nomina nuda.

2. The author of a genus or species is he who first gives it valid standing. A genus without species is a nomen nudum and thus without valid standing. Therefore the first writer to give it validity is the author and its date is that at which this validating is done. It would be absurd in my estimation to do otherwise as in such case we might have some good genus invalidated through preoccupation by a nomen nudum.—A. N. Caudell, U. S. National Museum. (Orthoptera.)

Mr. Caudell adds that Messrs. Dyar (Lepidoptera, etc.), Knab (Diptera) and Busck (Lepidoptera), of the National Museum, agree with the above statement.

Genera without included species " are nomina nuda."—A. A. Girault, University of Illinois. (Hymenoptera.)

I fully agree with you that the rule of the code quoted by Mr. Coquillett merely means that the genus name itself must be uninominal, and has no bearing on the question under discussion. A genus name without a type species is, I think, untenable; but if it be stated that the genus is founded on an undescribed species, then it might stand as you suggest.—Chas. A. Hart, Ills. State Lab. of Natural History. (Entomology.)

I saw your article in SCIENCE yesterday, and was much interested in it. There are several cases in botany where it seems to me a strict sticking to the letter of the law is a little awkward. Are we to write *Bossekia* Neck. or *Rubacer* Rydb.? It seems to me that Greene has proved that they are the same, yet Rydberg published combinations in *Rubacer* before Greene published them in *Bossekia*.

Mohrodendron and *Carlomohria* are in the same category. Everybody knows what Greene referred to when he published the name, yet he did not make any combinations at that time, and Britton did. If we follow the law exactly in such cases, we are departing somewhat from priority, and it does not seem altogether right to me.—A. A. Heller, Nevada Agric. Exper. Sta. (Flowering Plants.)

On question of validity of generic names when proposed without reference to published description of included species or in connection with such description, please record my vote in the negative. —A. W. Morrill, U. S. Bureau of Entomology.

A genus name can stand only when meeting requirements of binary names, it being recognized that a genus is a group of one or more species.— E. L. Morris, Museum of Brooklyn Institute. (Botany.)

I do not think a generic name should be recognized unless connected definitely with a binomial species. This is in accord with the American Botanical Code and is essential in order to provide types and definitely fix genera.—C. L. Shear, U. S. Dept. Agriculture. (Botany.)

It is probable that generic names published without reference to included species would be rejected by the majority of American zoologists and botanists, though at least some eminent authorities favor their recognition. Probably a more precise estimate of current opinion could be gained by sending out voting papers to all the more active or eminent workers. I venture to suggest that such a plan might be taken up by the American Association for the Advancement of Science. It would not be held or suggested that the votes thus obtained on controversial matters had any legislative significance; but they would undoubtedly have their influence in moulding opinion, while the invitation to vote would in many cases stimulate thought. It seems to me that in the publication of the results of any vote, the names should always be given,

unless the number is very large. In the latter event, representative opinions, with names, could be published.

Whether a plan of this sort could be extended to include the scientific workers of the world (or such of them as might be concerned with the particular matter under discussion) is a difficult question. Efforts of various kinds are being made at the present time to bring the scientific men of the world into closer touch with one another, and it is perhaps not quixotic to suppose that eventually they will be at least as ready and as competent to act together as are those of America at the present time.

T. D. A. Cockerell

University of Colorado,
March 28

THE FUTURE OF NOMENCLATURE

Professor T. D. A. Cockerell's discussion under the heading "Genera without Species" recently published in Science,[1] is of great pertinency at the present time.

Without discussing the question concerning the validity or non-validity of genera described without species named in connection with them, or genera proposed with undescribed types, a question familiar to every systematist, and one which I hope to see discussed by others more competent and learned than myself, I desire merely to make one or two general observations concerning nomenclature as a whole, its function and its future.

Before doing this, however, some remarks concerning the cases considered by Professor Cockerell may not be out of place or without some use.

In the first class of cases, a genus described in the past without a species named in connection with it, I consider as being non-existent—a *nomen nudum*—and it remains such unless subsequently its author or some other refers to it a properly described type species. The genus being non-existent, its name does not have to be recognized again as being that of a zoological unit, excepting as a matter of wisdom; if used again, it has no status unless used as a name based on some definite type species designated subsequent to its original description, and in such cases the original author of the name should be held responsible for it, mainly as a matter of clearness. I agree with Professor Cockerell's interpretation of the code in cases of this kind. Whether or not these *nomina nuda* made in the past should be used again depends largely on circumstances, and is almost a matter of individual judgment. I think they should be used in most cases to prevent questions of obscure homonymy, and confusion arising from other sources. These remarks bring me to the point I had in mind in regard to this class of cases. I have referred to them as occurring in the past. Should they be allowed to occur in the future? There is no excuse at the present time for cases of the kind being made, but some provision should assuredly be made in the code to prevent them. The code should state that after such a date (1900 recommended) genera proposed or described without species named in connection with them should be considered as being without status in nomenclature aud ignored accordingly, as newspaper descriptions are ignored. If this is possible, the systematists of the present and future will not have constantly accruing cases of the kind to deal with, or be in danger of their common occurrence, and the old cases would be gradually cleared up.

As to the second class of cases. We may not know, or attempt to define, the exact differences between a species and a genus in monotypical genera; still we do know as a matter of experience that when an author briefly defines a new genus in a diagnostic table of genera of a group and merely mentions a species as type, without describing it and yet follows the rules of binary nomenclature, he has not done all that is necessary to make it recognizable. As a matter of fact, we know that he has not described the species by diagnosing the genus, for the simple reason that the species can not be recognized. As a case in point: In a group of insect parasites of the Hymenoptera, the late Dr. Ashmead, in a table of the genera of a tribe of the Sphegigasterinæ describes or defines a new genus called *Pachycrepoideus*, merely naming a type

[1] N. S., XXIX., February 26, 1909, pp. 339–340.

species in parentheses, without describing it. As defined, the genus was based on but one or two general diagnostic characters. Just recently, I had occasion to deal with the genus in connection with certain parasites of the common house-fly (*Musca domestica* Linnæus); the species of parasite agreed with the brief description of the genus in every particular, as far as it went. The question arose, was it the type species. To decide from the description of the genus was nothing less than pure guesswork. *The generic description or diagnosis did not characterize the species.* Fortunately, I knew that the type species was in the National Museum at Washington and through the kindness of the authorities of that institution I learned that the species which I had under consideration was not only not the type species of *Pachycrepoideus*—a fact which was not strange—but that it differed so much from the genus itself, in other structural, generic characters not mentioned in the description, that it formed a distinct genus in the same division of the tribe.[2] This case is but one in a number of similar ones which occur in the parasitic Hymenoptera. To say that the type species of this genus is described is to say, it seems to me, that naming a thing describes it. To hold such a view is to recommend the practise of naming instead of describing, which is practically what the case just cited amounts to. It is merely another way of saying that to generalize on the whole, is describing and making recognizable all of the component parts. As genera are being described at the present day, even, the practise is a most dangerous one, for unless the type species are soon described they become unrecognizable, the genera practically come under the first class of cases considered, and progress demands a removal of the obstructions and they fall or have to be reconstructed. Future cases of this kind should be prevented.

The main point to which I wish to call attention, however, is not what to do in past cases of the kind considered, but what to do in order to prevent their occurrence in the future. In this matter, we must leave the past behind us and build for the future. Looking ahead, not behind, the whole question of nomenclature turns on a single point, that of identity. If those who come after are to build upon what we are doing in the present, stability in nomenclature will primarily depend on the means we leave behind us for the identification of the things we name. Nomenclature, as we all know, is but the tool, the means to the end of systematic work; the end is fundamentally concerned with identity, identity based on, and dependent upon, definition or description. In the great present-day activity in systematic work, enlightened by past failures and errors, it seems to me to be a deliberate fault for a systematist to cause cases like the kind we have considered. We must all know that what in the far past was regarded as a genus, to-day has become a family or other higher group, and in all probability what is regarded as a genus to-day, in the future may become a much higher group. We have all learned, ere this, that the greatest causes of error, delay and obstruction to progress in systematic zoology at the present time is the meagerness of definition or description of genera and species. Of what use is it to us, to the future, to the race at large, to science, for a systematist, although a recognized authority in the group in which he is working, to describe briefly, unrecognizably, new genera or new species? Does the fact that we know through his efforts that they exist help any of us, help science? Assuredly not; if the units are not recognizable they are nothing more or less than obstructions. Fifty years hence, the systematists will be considering them under the same general classes of cases that we at the present are considering the poorly described genera and species of fifty or more years ago. Having what will then be considered but one or two very general diagnostic characters upon which to base conclusions, in all probability they will be at an utter loss to know into what families or other groups to place them. Of what possible benefit is it, therefore, to describe these things unless we use in every case all the means at our command to make them

[2] I have since learned that my species was the type species of *Pachycrepoideus*. This does not alter the case.

recognizable; will they not in the end become mere *nomina nuda?*

Identity being the fundamental basis of nomenclature, and intimately connected with the end of systematic work itself, it seems utterly absurd to ignore it or to give it but passing attention. Therefore immediate steps should be taken to insure it. Instead of having an international code of nomenclature *recommended* to zoologists, to be followed at their discretion, we have advanced far enough to have one which should be *enforced* by legislation of some such body as the International Zoological Congress, no systematist being recognized unless adhering rigidly to its rulings. At first thought this step may appear to be visionary, as we can not by law control such intangible or incorporeal things as the individual judgments of men concerning what is or is not a good description of a thing; nevertheless, we can prescribe, in cases of the kind considered, what shall or shall not be done in the future. Genera described without species can be rigidly barred; genera described without a description of the type species upon which they are based can be treated likewise. The authors of such genera could be reprimanded or discountenanced, in a sense proscribed. Further a date of departure for a new system of nomenclature based on the future should be designated, for the questions of the past should be studiously avoided in the future, and the new code should be conceived in the spirit of the future, that is to say, in the spirit of expansion, of progress. Such a code, for instance, could provide for the future cases coming under article 21 of the international code, which should be framed along lines tending to make descriptions infinite in detail. For example, an *indication* should not be allowed to hold for present-day or future descriptions and some provision should be made for the compulsory deposition of types in accredited museums. I have mentioned but one or two points which such a code should be expected to cover; for its development and adoption I can hope only; for these few suggestions, I beg the consideration due to the spirit in which they are offered.

The end should always be in mind; we must broaden our view-point; let us look to the future, for properly the present belongs to it.

A. Arsène Girault

University of Illinois,
March 1, 1909

SCIENTIFIC BOOKS

The Origin of the Vertebrata. By Walter Holbrook Gaskell. Longmans, Green & Co. 1908.

Professor Gaskell during the past two decades has published an extended series of papers which have aimed to convert morphologists to the view that vertebrates are descended from arachnids. These papers, with additions and corrections, are now brought together in volume form. We suggest, however, the book's title "The Origin of the Vertebrata" is chosen inaptly. It should have read "The Supposed Arachnid Origin of the Vertebrata," or, better, "A Plea for the Rejected Theory of the Origin of the Vertebrates from Arachnids." For it is hardly fair that the purchaser of this book should believe that he has here a résumé of our knowledge of the ancestry of the vertebrates. He is given merely a one-sided view of the whole intricate problem.

It is just to say that Gaskell has devoted himself generously to the task which he has sought to accomplish. His work shows that he has been earnest and tireless, that his reading has covered a field much wider than that of the usual promoter of a lost cause—that he is not one of those whose effort is measured in terms of success, for he would himself admit that even his friends (and he has many sympathetic ones) in the wide zoological fraternity, do not subscribe (there is scarcely an exception) to a single tenet of his heretical morphology. If he had been trained as a morphologist instead of as a physiologist, perhaps he himself would never have developed his theory.

There has been of late years a tendency to ignore Gaskell's writings on the ground that his arguments, having been weighed carefully, have been found wanting. Then, too, we have lost zest for discussing his difficult theses, *e. g.*, that the arachnid gut and nervous cord fused

to establish the tubular vertebrate nervous system; that the vertebrate gut is a new structure formed by the fusion of the bases of arachnid appendages; that the notochord was later formed from this new gut; that the arachnid genital ducts were retained as the vertebrate thyroid; that the arachnid genital tissue and liver became converted into the arachnoidal fat which fills the brain-case and invades even the skeletal capsule of the vertebrate ear; that Kupffer's sensory plakodes are reminiscent of arthropod appendages; that coxal glands are the homologues of both the pronephros and thymus; that the wide discrepancy in the plan of the embryonic development of arthropod and vertebrate, as in the inversion of the dorso-ventral orientation, is a mere detail caused by the shifting of the mass of the yolk.

One hesitates at this day to reopen an indigestible discussion. And it would be profitless were it not that the volume has brought forward the theory in such a pleasantly written and well-published fashion, which will give it in all probability a wide circulation. The present review need comment on but a few of its teachings—those which touch fundamental conceptions in morphology.

I. Gaskell maintains the doctrine that evolution proceeds (genetically) from the dominant type of one geological horizon to the dominant type of the following geological horizon. This is a doctrine which at the best is intangible and unconvincing. Even the example cited by Gaskell does not support his case—that the vertebrates in their earliest occurrence superseded the sea-scorpions of the early Paleozoic. For at that critical time it was the cephalopods (*e. g.*, the huge Orthoceratids), not the sea-scorpions, which were the dominant race. However, for the sake of argument, granting that the cephalopods are lower than arachnids, they are obviously much higher (measured by the standard of the nervous system) than the lower crustaceans or the worms, hence by the doctrine of dominant types they should have taken an intermediate genealogical position between the crustacea and the arachnids, which even Gaskell would deny.

II. Gaskell seems to have little conception of parallelism, and he is probably, therefore, unaware of the mighty literature dealing with his theme. This is the more regrettable, since it is this principle which bears so directly upon phylogenetic studies. For it can now be demonstrated beyond peradventure that animals, *e. g.*, of different orders, may develop similar structures to such a degree that they are sometimes mistaken for members of the same family or even genus. And if this be true, how can we believe that certain specified resemblances of king-crab to vertebrate can be accepted as tests of genetic kinship? If such a form as a Litoptern can develop many essentials of a horse, yet be not included within the great group of Ungulates, how can we accept Gaskell's elaborate details when he compares forms as widely apart as a vertebrate and an arachnid? An arachnid has no tubular nervous system, no gill slits, no notochord; it has widely different appendages, skeleton, skin, urogenital system, sense organs—how therefore do we venture to compare its details with such vertebrate structures as the abducens, or the various branches of the fifth nerve, or the jaw muscles? We might, in fact, make a comparison of this kind as convincingly, or unconvincingly, by selecting the structures of a cephalopod. In a word, it is this kind of comparison which makes the distressed reader cast down Gaskell's book even when assured by the author that the evidence of these "homologies amounts almost to a certainty."

III. Gaskell fails to take into account a fundamental rule in descent study, that *series* of forms whose structures are the most closely connected should be used for comparisons. This rule he violates constantly when he compares the Paleozoic *Cephalaspis* and the recent lamprey-larva, *Ammocœtes*, for these forms are by no means the nearest links in a possible chain. As a matter of fact, we now known that *Cephalaspis* is but one example of a great group of Paleozoic creatures, that these creatures show the greatest range in forms and structures, and that many of them are unlike arachnids even in superficial regard, in fact some of them are soft-bodied and covered with shagreen like a

shark. It is, accordingly, by no means to be accepted that these creatures are nearly akin to *Limulus*, even if cases of superficial resemblance be pointed out. For the general outward shape of *Limulus* may be acquired independently by creatures of very different groups, even to a certain degree among vertebrates by rays and siluroids. On the other hand, it is clear that ammocœtes should be compared at first not with a Paleozoic form of dubious kinship, but with other cyclostomes, especially with the hag-fishes, which Gaskell rarely mentions. The fact is that after comparison with the latter forms, we are less inclined to regard the ammocœte as a primitive and unmodified creature. For we find that the hag-fishes have no metamorphosis, and we may, therefore, more easily harbor the suspicion that the exceptional sand-living life habit of the larval lamprey has been responsible for many of its curious features, and that these have no wider phylogenetic bearings than have, for example, the peculiar larvalisms developed by many teleosts. But let us not go into details. The momentous problem of vertebrate beginnings is still "on the knees of the gods." We gravely doubt whether Gaskell's book will be of great value in dislodging it.

Bashford Dean

Modern Thought and the Crisis in Belief. The Baldwin Lectures, 1909. By R. M. Wenley. New York, Macmillan. 1909. Pp. ix + 364.

This volume results from the nomination of Professor Wenley by the Protestant Episcopal Bishop of Michigan to give a series of lectures in an endowed course "for the Establishment and Defence of Christian Truth." The circumstance will, perhaps, not especially commend the book to the interest of some readers of this journal. Few ways of spending money seem to some modern minds less desirable, or more productive of ethically awkward situations, than the creation of permanent foundations for scholarly inquiries or discussions, whose results are predetermined by the terms of the endowment supporting them; this is true whether the predetermined result be the truth of Christianity or the truth of socialism. With old foundations of this sort we must do the best we can; but it is a somewhat regrettable anachronism that new ones should appear in recent years, and in connection with American universities. One can hardly suppose that the Christian truths which Professor Wenley establishes and defends would have been recognized as such by the episcopal founder of the lectureship, no longer ago than 1885. The book is almost equally divided into a destructive criticism of religious beliefs still current, and philosophical reconstruction; but one apprehends more clearly what it is that is destroyed than what it is that is constructed. The best, and the longest, division of the book deals with a topic that does not call for discussion here: the religious consequences of historical criticism; the outcome is a frank abandonment of the historical character and content of Christianity, and the transfer of interest from a historic teacher to a "metahistorical Christ." The precise ontological status of this entity, and its relation to the historic Jesus, remain obscure to the present reviewer. The other main division of the book concerns the religious bearings and the philosophic validity of the "natural science view of the world"—the doctrine unfortunately labeled by Ward "naturalism," by which appears to be meant a mechanistic cosmology, biology and psychology taken as equivalent to a complete account of the nature of reality. With this, Professor Wenley vigorously argues, religious thought must now have a definite reckoning; for while historical criticism can destroy nothing essential to religion—since nothing historical is essential to religion—naturalism is the "executioner of the ideal life." Since the refutation of naturalism is presented as the main task, not only of this book, but of the present age, one is disappointed to find Professor Wenley devoting expressly to it only some forty pages—one ninth of his space. It should be said, however, that the author regards the task as one for the most part already accomplished, by Ward's "Naturalism and Agnosticism," which he here, so to say, reënacts. His own argument rests chiefly upon two points: (1) Every science begins by deliberately abstracting certain as-

pects of the world from their context, which none the less really conditions them; the conclusions, therefore, of any science become, if generalized and made applicable to the whole, not only inadequate but self-contradictory. (2) Likewise, if the generalized results of science conflict with ideal interests they stultify themselves; for the abstraction from which they arose was for the sake of an ideal. While the reviewer sympathizes with much in Professor Wenley's doctrine, he does not think these arguments calculated to convince. (1) To say that the conclusions reached primarily by segregating and analyzing a certain aspect or type of phenomena are *necessarily* inapplicable and absurd beyond the limits of that segregation, is to say that no unification of knowledge is possible at all. Science assumes that phenomena seemingly complex and diverse can ultimately be understood as special variations—under conditions also generalizable—of a simple and homogeneous type-phenomenon, or of a few such. This assumption is very possibly unwarranted; but it is not comic, and it is not to be disposed of by so easy a piece of dialectic as that employed by the author. (2) Many principles of science are undoubtedly postulated ideal demands. There is no necessary paradox in the opposition of these intellectual ideals to ideals of another order and origin. The question—which this book does not very explicitly discuss—is: When they conflict, which has the right of way?

One could wish that Professor Wenley would be persuaded to chasten his style. At its best it is admirably vigorous and effective; but there are moments in which it seems a cross between the style of the Delphian oracle and that of Mr. George Ade. In such passages the simple, precise and natural expression is laboriously avoided in the interest of strange archaisms and neologisms and a general grandiloquent incomprehensibility. Thus the reader is told that "a mystic element is the *leit motiv* of the fiducial process"; what he is expected to gather is uncertain, but the reference at any rate is *not* to the religious propensities of bankers. One learns of "the [illegible] means whereby acute need for God is brought home to the secular group"; one is warned that "while it would be sheer ingratitude to lightlie these [historical] investigations, it is quite another affair to train with their representatives when," etc.; one is assured that "God is the normative content of human life"; and one makes the acquaintance of such supernumeraries of our speech as "to gift a procedure" (meaning, simply, to give a procedure), "derivant" (for derivative), "a quantitative phantasmagoria," "misfortunately," "his near kith."

ARTHUR O. LOVEJOY
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ON THE NATURE AND POSSIBLE ORIGIN OF THE MILKY WAY[1]

WHILE the milky way has long been recognized as a relatively thin segment of space in which stars appear more numerous than elsewhere, no satisfactory explanation has been offered for the existence of such a segment with the earth apparently at its center or for any of its characteristic peculiarities of aspect and relationship to the stars as a whole. Noteworthy among the features calling for explanation are the following: The milky way is a belt approximately following a great circle of the sky but broad and diffuse throughout one half of its course while relatively narrow and well defined on the opposite side. The broad half of the belt is cleft in two by a dark lane running along its axis and in addition contains numerous rifts and holes from which the narrow half is relatively free. The number of stars per unit area of the sky is a maximum in the milky way and diminishes progressively on either hand, while the inverse relation is true for the nebulæ, their frequency increasing with increasing distance from the milky way.

It is shown in the present paper that all these peculiarities are immediate results of the supposition that the visible universe consists in the main of two distinct but interpenetrating parts, the first of which is a chaos of indefinite extent in which stars and cosmic

[1] Abstract of paper read at the April meeting of the National Academy of Sciences by George C. Comstock.

dust are distributed with some rough approach to uniformity in general, but with a marked tendency to local aggregations and clusterings. Through this chaos moves the second part, a cluster of stars of great but measurable dimensions, long, broad, but comparatively thin and including the sun as one of its central members. The diameter of this cluster is to be measured in hundreds of light years and throughout at least a large part of its central regions the stars are much more densely clustered than in the external chaos.

In accordance with well-known dynamical laws this moving star stream would operate much after the fashion of a snow plow, sweeping away the cosmic dust from its path and piling it on either hand, above and below the plane of the cluster. The transparent rift thus formed is the milky way through which we see farther and command a view of more stars than through the intensified dust clouds on either side. The dust ejected toward the poles of the milky way constitutes the substance of the nebulæ which there abound.

The narrow half of the milky way is that which lies behind the moving swarm, since here we see the accomplished work of ages and look between dust clouds, long since produced, that converge to a vanishing point. Ahead, in the direction of motion, the work of clearing a path is in progress and relatively near at hand, so that the partially cleared space subtends for us a broader angle, in the midst of which there are collected considerable quantities of primordial dust, the slower-moving particles, which have been captured and permanently annexed by the vanguard of the swarm. The annexed dust cloud constitutes the long cleft in the milky way, while its attendant holes and rifts mark unfinished work on the inchoate side of the galaxy.

The interpretation of the milky way here offered must not be judged solely by its consonance with the phenomena above suggested. It must harmonize with every other fact known about the milky way and it has been the task of the author to seek widely for discord as well as harmony between such facts and the theory above outlined, making the test, wherever possible, a quantitative numerical one. No serious discordance has been found, but the agreement with knowledge hitherto vaguely (or not at all) correlated with the milky way is in some instances striking. Thus the researches of Kapteyn, Eddington and Dyson upon the proper motions of the stars have shown that in the main these bodies belong to two groups in relative motion along the line and in the direction above suggested in explanation of the milky way. Again Pickering has recently announced certain well-marked differences in the distribution of stars of different spectral types, viz., the fainter stars of the galaxy are almost wholly of the first (Sirian) spectral type. The number of stars of the first type increases with diminishing brightness in a four-fold ratio for each successive magnitude, as theoretically it should increase if these stars were uniformly distributed through infinite space. Per contra, stars of the second type (solar) increase from magnitude to magnitude only in a ratio represented by the number 3.25, thus implying a distribution very unlike that of the first type stars. All three of Pickering's propositions, together with similar ones earlier formulated by Seeliger for the totality of stars, without distinction of spectral type, are numerically accounted for by the supposition that the stars composing the primitive chaos are mainly of the sirian type while those of the solar group are predominantly of the solar type. By direct enumeration Eddington finds that this relative predominance of spectral types is shown in the two groups into which the stars are divided with reference to their systematic proper motions.

It is easily seen to be a necessary corollary from this explanation of the milky way that stars in or near the galaxy should on the whole appear to move more slowly across the sky than do similar stars remote from the milky way, and that this predicted result is in fact true has been shown by at least two astronomers. Another interesting corollary may be derived through the supposition that a star belonging to the solar group may by virtue of its motion be made to pass so near to one of the sirian stars as to produce disturbances, one upon the other, that will long remain

marked by some peculiarity of spectrum. If such were the case the stars so marked should be found only in or near the milky way and they should be especially numerous and compactly clustered astern of the solar group, they should be more sparsely distributed ahead of it and should be almost completely lacking on either side of the procession. The so-called Orion stars constitute just such a set of objects, marked and distributed as above and presenting the further peculiarities that their apparent motion across the sky is abnormally small and that their number shows no tendency to increase as we pass from the brighter to the fainter magnitudes. All of these characteristics are such as would be possessed by stars formed as above suggested.

In a somewhat similar class are the new or temporary stars believed to result from collisions of some kind and found only in or near the milky way. Why they are limited to the milky way is now apparent, since that is the region, according to the present hypothesis, in which large relative motions are to be expected.

We may look upon double stars as produced by the close approach of a solar to a sirian star under circumstances such that the gravitational bond between them becomes too strong to be broken and the two bodies abide thenceforth in enforced partnership. The size and shape of the orbits in which they shall move about their common center of gravity are determined by the circumstances of their meeting and an elementary analysis suffices to show that the circumstances that tend to produce a small orbit will equally tend to make that orbit nearly round, while those which make a large orbit will equally tend to make it more pronouncedly oval. A statistical examination of double stars shows that they do in fact show this relation among themselves, a small major axis being predominantly associated with a small eccentricity, an agreement between fact and theory that can hardly be accidental.

The test of a valid theory is its power to coordinate apparently unrelated facts without coming into conflict with any of them and, in view of the illustrations of such coordination given above and of others for which space does not here suffice, there is here presented the concept of a definite group of stars moving through a much more widely extended chaos as the best working hypothesis at present attainable with reference to the stellar system.

BOTANICAL NOTES

OUT OF DOOR BOTANICAL STUDY

WITHIN a few weeks students who are planning out of door study in the summer vacation will decide where they will go. In the hope of being able to help such students to decide wisely we here bring together in summary form abstracts from the announcements made by the directors of half a dozen laboratories.

The oldest laboratory of this kind is the Marine Biological Laboratory at Woods Hole, Mass., whose twenty-second session extends from June 1 to October 1. In addition to instruction in botany, zoology, embryology and physiology, opportunities are afforded for investigation in these departments of biology. For botanical students instruction is offered (1) in the morphology and taxonomy of the algae, and (2) the morphology and taxonomy of the fungi. Five buildings with fifty-five private rooms for investigations, and seven general laboratories, constitute the plant, and are supplied with aquaria, collecting apparatus, reagents and glassware. The laboratory has a steam launch, boats, dredges and the apparatus necessary for collecting and keeping alive material for class use or research. Dr. George T. Moore, of Water Mill, N. Y., is in general charge of the botanical work.

The twentieth session of the Biological Laboratory at Cold Spring Harbor, Long Island, begins July 7 and closes August 21. Opportunities for instruction and investigation in botany and zoology are offered. In botany the instruction includes courses in: (1) Cryptogamic botany—especially algae and fungi, and (2) ecology. The laboratory possesses three buildings for study purposes, supplied with needed appliances, and five dormatories, accommodating seventy-five persons. A 28-foot motor boat, with small boats,

collecting apparatus, etc., are supplied. Professor D. S. Johnson, of Johns Hopkins University, Baltimore, Md., is in general charge of the botanical instruction.

The tenth session of the Harpswell Laboratory at South Harpswell, Maine (sixteen miles from Portland), will be held June 14 to September 11. The laboratory is intended for research students only, and for their accommodation has one building affording facilities for fifteen persons. A motor launch, small boats, nets and dredges are provided for collecting, while in the laboratories are glassware, aquaria, microscopes, microtomes, etc., for the work of investigations. Professor J. S. Kingsley, of Tufts College, Mass., is in general charge of the laboratory.

The Minnesota Seaside Station at Port Renfrew, on the west coast of Vancouver Island, will resume its sessions this year, after a vacation of a year. There are two laboratory buildings, and one dormitory and mess hall, for the use of students. The large brown seaweeds are more than usually abundant along the coast near the station, while the forests of this part of the island are wholly unbroken. The session begins about July 6 and ends about the middle of August. Professor Josephine E. Tilden, of the University of Minnesota, Minneapolis, Minn., is in general charge of this station.

The first session of the Marine Biological Laboratory of the Washington State College will be held at Olga, on Orcas Island, in the northerly part of Puget Sound, beginning June 21 and continuing to July 30. The immediate surroundings include the open waters of the sound with their rich marine flora, the tide flats, open land, forests, nearby freshwater lakes, Mt. Constitution (2,400 ft. alt.) with ravines, waterfalls, swamps, etc. A motor launch, row boats, dredges, collecting apparatus, microscopes, etc., are supplied. Instruction and opportunities for investigation are offered in botany and zoology. Professor R. K. Beattie, State College, Pullman, Wash., is in general charge of this station.

Allied to the foregoing is the Mountain Laboratory of the University of Colorado, whose first session will be held (June 14 to July 24) at Tolland, Colorado, in a mountain park at an altitude of nearly nine thousand feet altitude above sea-level. This point is eighteen miles southwest of Boulder, and is in the midst of hills, mountains, moraines, ravines, brooks, mountain meadows and ponds. The rich forest vegetation of the near-by region, and the "timber line" and alpine vegetation within easy reach, afford many interesting ecological problems. Courses in general biology, nature study, plant ecology, anatomy and taxonomy are offered, and opportunities are given for individual work and investigation. Professor Francis Ramaley, of Boulder, Colo., is in general charge of the laboratory.

SOME SOUTH AFRICAN BOTANY

From far-away South Africa comes a handful of papers by Professor Joseph Burtt-Davey, the agrostologist and botanist for the Transvaal Department of Agriculture. Quite naturally these papers have a strong agricultural bias, yet in all of them the scientific botanist may find much that will throw light upon the native vegetation of the region. One of the most interesting of these papers is that on the "Native Trees of the Transvaal" (1907), in which 269 species, representing 57 families, are recorded, and the additions made during the following year and reported in another paper, bring these numbers up to 336 species and 58 families. These are distributed through four well-marked zones, viz: (1) "The Mist-belt Forest" on the upper eastern slopes of the Drakensberg mountains, where the rainfall is heavy and the atmosphere humid. "A characteristic feature is the evergreen character of the trees, the common occurrence of epiphytes, lianes and ferns":—(2) "The High veld zone," consisting of a typical grass-steppe region, in which trees are rare. It descends to about 4,000 feet altitude: (3) "The Middle veld zone," known also as the "Bush veld," and for the most part loosely covered with trees so as to constitute a "Savannah" region rather than a real forest: (4) "The Low veld zone," restricted to the country lying below 1,500 feet altitude, and also a "Savannah" region.

Looking over the lists one notes species of *Podocarpus* (*Taxaceae*) and *Callitris* (*Pinaceae*), *Phoenix* and *Hyphaene* (*Palmaceae*), many genera and species of *Anacardiaceae, Celastraceae, Ebenaceae, Flacourtiaceae, Leguminosae, Moraceae, Proteaceae* and *Rubiaceae*. Very few of the genera are identical with ours, although one may find such names as *Rhus* (with over 20 species), *Ilex, Diospyros, Euphorbia, Vaccinium, Ricinus, Acacia, Mimosa, Cassia, Ficus, Olea, Rhamnus, Cephalanthus, Xanthoxylum, Salix, Celtis*. Aside from these the genera are quite unfamiliar to the American dendrologist.

The other papers include such topics as the breeding of maize, ramie cultivation, plants poisonous to stock, and the cultivation of alfalfa (lucerne). The latter is very full, and includes over eighty pages, with a number of illustrations.

A NEW BOTANICAL JOURNAL

EARLY in the year (February 27) the first number of a new journal appeared under the name *Mycologia*. On the title-page it is said to be "in continuation of the *Journal of Mycology* founded by W. A. Kellerman, J. B. Ellis and B. M. Everhart in 1885." It is to be "published bimonthly for the New York Botanical Garden." About the middle of April the second (March) number appeared, and we are thus able to judge as to what the new journal is to be like. The first number contains a good colored plate of agarics and pore fungi, and one black-and-white plate. The text includes twenty-six pages, and the articles are entitled "Illustrations of Fungi, I.," "The Boletaceae of North America," "Notes on North American Hypocreales, I.," "A Bacterial Disease of the Peach," "The Problems of North American Lichenology" and "Notes and News." The second number contains one colored plate of agarics and three black-and-white plates, and the text includes forty-six pages. The papers are, "Illustrations of Fungi, II.," "The Hypocreales of North America, II.," "Filling Tree Cavities" and "Notes and News."

The journal is well printed and is a worthy continuation of the *Journal of Mycology*. At the moderate price of three dollars per year it will, of course, be indispensable in every botanist's library.

LEO ERRERA

NEARLY four years ago the noted Belgian botanist Leo Errera died in his forty-seventh year. Born in 1858, he very early displayed a brilliancy of mind which indicated what he was to become in his maturity. Receiving his doctorate from the university, he studied also with Sachs, DeBary, Hoppe-Seyler, Waldeyer, Stahl and others, and became personally acquainted with Bower, Vines, Klebs, Schimper and other noted botanists of Europe. Then began a life of incessant activity, during which he prepared and published nearly three hundred papers. The earliest of these appeared when he was but a youth of seventeen years, while the last ten appeared within a year or two after his death, after having been completed by willing friends.

There is now appearing in Brussels a collection of the works of Errera under the title "Recueil d'Oeuvres de Leo Errera" which is to be completed in six volumes. The papers thus brought together (and they are a selection from all his publications) are of two kinds, viz., (1) those addressed exclusively to specialists in botany and physiology, and (2) those intended for "non-specialists who read and think." Those volumes have already appeared, viz., I. and II., devoted to general botany, and VI., containing miscellaneous papers in prose and verse. The third volume is to be devoted to general physiology, the fourth to philosophy, while in the fifth will be found pedagogical and biographical papers. The beauty of these volumes, their good paper and clear type commend them as a fitting memorial worthy of the man whom they honor.

CHARLES E. BESSEY
UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

DETERMINATION OF THE COEFFICIENT OF CORRELATION

IN statistical work it is often necessary to determine the coefficients of correlation between a number of variables, the calculation

of which according to the usual method of correlation tables occupies much time, while the subdivision into larger groups makes the results inaccurate. The following method of calculation secures a great saving of time and labor. The averages and mean square variabilities of all the variables must be determined. By forming the differences between any series of pairs, we find the values of $x - y$, which may be treated like any variable. Indicating averages by brackets, we have

$$\begin{aligned} [(x-y)^2] &= [x^2] + [y^2] - 2[xy] \\ &= \sigma_x^2 + \sigma_y^2 - 2r\sigma_x\sigma_y \\ -r &= \frac{[(x-y)^2] - \sigma_x^2 - \sigma_y^2}{2\sigma_x\sigma_y} \end{aligned}$$

For a single correlation there is not much saving of time in this method of calculation, but in multiple correlations a very large amount of labor is saved.

A similar device may be used in the calculation of correlations of fraternities. When the deviations for members of a fraternity are designated by $x_1, x_2, x_3 \cdots x_n$,

$$[(x_1 + x_2 + x_3 + \cdots + x_n)^2] = n\sigma_x^2(1 + \overline{n-1}r)$$

$$r = \frac{[(x_1 + x_2 + \cdots + x_n)^2]}{n(n-1)\sigma_x^2} - \frac{1}{n-1}$$

A similar method will allow the determination of the average correlation of a large series of variabilities. By reducing each variable to multiples of its variability, we find

$$\left[\left(\frac{x_1}{\sigma_1} + \frac{x_2}{\sigma_2} + \cdots + \frac{x_n}{\sigma_n}\right)^2\right] = n + r_{1,2} + r_{1,3} + \cdots + r_{n-1,n}$$

$$[r] = \frac{\left[\left(\frac{x_1}{\sigma_1} + \frac{x_2}{\sigma_2} + \cdots + \frac{x_n}{\sigma_n}\right)^2\right]}{n(n-1)} - \frac{1}{n-1}$$

Correlations of phenomena that can not be measured, but only counted, may be treated in the following manner: If two events that have the probabilities p_1 and p_2 are correlated, we may say that those cases in which the event 1 occurs have the probability 1, or a deviation from the normal probability $1 - p$.

Those cases in which the event 1 does not occur have the probability 0, or a deviation from the average probability of $-p_1$. If we call p_2' the probability of the event 2 when event 1 occurs, p_2'' the probability of event 2 when event 1 does not occur, and q_1 the coefficient of regression of 2 upon 1, we have

$$\begin{aligned} p_2' - p_2 &= q_1(1 - p_1) \\ p_2'' - p_2 &= -q_1p_1 \end{aligned}$$

Thus the phenomenon corresponds strictly to that of measurable variables, and the procedure may be followed that is applied in the calculation of the coefficient of correlation of measurable variables. It follows that

$$p_{1,2} = p_1p_2 + q_1p_1(1 - p_1)$$

We designate, as usual,

$$q_1 = r\frac{\sigma_2}{\sigma_1}$$

$$q_1 = r\sqrt{\frac{p_2(1-p_2)}{p_1(1-p_1)}}$$

$$p_{1,2} = p_1p_2 + r\sqrt{p_1(1-p_1)p_2(1-p_2)}$$

$$r = \frac{p_{1,2} - p_1p_2}{\sqrt{p_1(1-p_1)p_2(1-p_2)}}$$

The correlation between a measurable and an unmeasurable quantity can be determined in a similar manner. When the measurable quantity is grouped as an array of the measurable quantity, we find, using the same symbols as before,

$$\begin{aligned} [x'] &= q_1(1-p) \\ [x''] &= -q_1p \\ \therefore \quad [x'] - [x''] &= q_1 \end{aligned}$$

$$\text{or} \quad q_1 = \frac{[x']p}{p(1-p)}$$

$$r = \frac{[x']p}{\sigma_x\sqrt{p(1-p)}} = \frac{-[x''](1-p)}{\sigma_x\sqrt{p(1-p)}}$$

From these formulas, multiple correlations may be calculated according to the same formulas as those used for measurable variables.

Franz Boas

Columbia University

THE ENZYMES OF OVA—INFLUENCED BY THOSE OF SPERM?

Some few summers ago, while working in the laboratories of the Biological Station at Woods Hole, Mass., the writer began some experiments to ascertain whether or not the action of the enzymes of ova were in any measure increased or decreased by those of sperm. The problem was suggested by the work of other investigators which showed that some enzymes have an interdependent action. It was also conceived that the process of fertilization might be due to the acceleration of

the enzyme action of the eggs by virtue of the presence of the enzymes of the spermatozoa. If such were the case the accelerated enzyme action might be demonstrated in the test-tube.

The results of the tests were in no measure conclusive, and the writer had hoped that he would have an opportunity to pursue the problem further, and for these reasons no reports on the investigation were made. As it seems that the work in which the writer is now engaged will prevent his having opportunity to repeat the experiments, a succinct general report of the work will here be made.

Star fish were chosen because they afforded a plentiful supply of both eggs and sperm, and because they were easily obtained from the waters about Woods Hole. The males and females were carefully washed and kept separate. The eggs and sperm were thoroughly ground by mortar and pestle; the power of each to split starch, fat and hydrogen dioxide was tested. Three tubes were used in each case. In tube 1 was placed 5 c.c. of ground eggs, 5 c.c. of starch solution and 5 c.c. of water. In tube 2 was placed 5 c.c. of ground sperm, 5 c.c. of starch solution and 5 c.c. of sea water. In tube 3 was placed 5 c.c. of the ground eggs, 5 c.c. of the ground sperm and 5 c.c. of the starch solution. The tubes were allowed to stand at room temperature for a considerable time, after which the contents were tested for sugar by the reduction test. It was found that there was only the slightest trace of reducing substance in tubes 1 and 2, whereas in tube 3 there was a very distinct amount present. These experiments were repeated perhaps six to ten times and the results were conflicting. They were neither consistently negative nor consistently positive. Nor were they sufficiently often positive to convince one that when they were positive it was not an accident. Comparable experiments to the above were carried out with butyric ether and hydrogen dioxide. The results were equally exasperating as those with starch. Whether the positive results were entirely the result of error or whether the negative results were due to the use of unmatured eggs or sperm it is impossible to say. It seems, however, that the results were such as to justify a careful repetition of the experiments, and it is hoped that some capable man who is interested in the problem will take it up.

It is a well-recognized fact that a large number of the female star fish contain a large number of eggs that appear in every way normal, mature and ready for fertilization and yet will not develop when sperm is placed with them. It seems that it may be possible that this would account for the varying results.

ORVILLE HARRY BROWN

NOTE ON THE ACCESSORY CLEAVAGE IN THE HEN'S EGG[1]

HARPER[2] has shown that polyspermy normally occurs in the pigeon's egg. His figures indicate that from twelve to twenty-five sperm-nuclei are formed in the egg. Only one of these, however, becomes a functional sperm-nucleus; the others migrate from the points of entrance to the periphery of the disc where they become active, dividing and giving rise to the "accessory cleavage." There is thus formed around the primary cleavage, which is produced by the divisions of the segmentation nucleus, an area of small cells. Blount[3] has later shown that these supernumerary sperm-nuclei live but for a short time, and then degenerate. She estimates the time of their disappearance as coming between ten and twelve hours after fertilization.

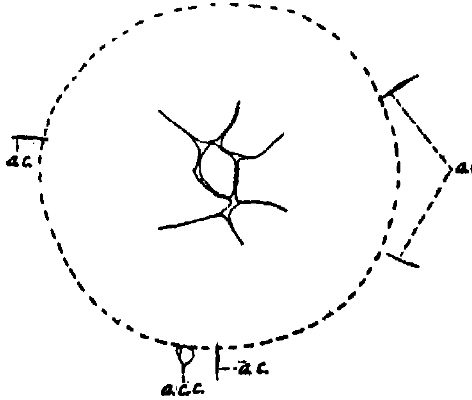
In the hen's egg accessory cleavage has neither been figured nor described. On taking up the study of the early development of this egg I was, therefore, greatly surprised to find an accessory cleavage. Not only can the furrows be seen in the living egg, but I also have preparations of surface views in which they stand out with diagrammatic clearness.

[1] Publications from the Zoological Laboratory of the University of Texas, No. 96. The writer is greatly indebted to the trustees of the Elizabeth Thompson Science Fund for a grant with which to carry on this work.

[2] E. H. Harper, "The Fertilization and Early Development of the Pigeon's Egg," *Amer. Jour. of Anat.*, Vol. III., No. 4.

[3] Mary Blount, "The Early Development of the Pigeon's Egg, with Especial Reference to the Supernumerary Sperm Nuclei, the Periblast and the Germ Wall," *Biol. Bull.*, Vol. XIII., No. 5.

The earliest stage at which I have observed the accessory cleavage is the four-cell. It takes place outside of the area occupied by the primary cleavage, and the planes of the furrows usually coincide with radii of the disc.



Eight-cell stage of the hen's egg. The egg was taken about twenty hours before the time of laying. *a. c.*, accessory cleavage furrows; *a. c. c.*, a small accessory cleavage cell. The dotted line represents the limit of the area of primary cleavage.

The number of accessory cleavages is at no time great. The greatest number so far observed is shown in the accompanying sketch. The actual number, however, may be slightly greater than is indicated by surface views, because in the sections of at least one egg, I have found that not all of the cleavages come to the surface, but some occur in a horizontal plane. That these cleavages are accessory is evidenced by the fact that their accompanying nuclei greatly simulate the supernumerary sperm-nuclei figured by Harper for the pigeon.

Shortly after the stage figured above the accessory cleavages disappear. A detailed study of sections will have to determine whether their disappearance is to be correlated with the degeneration of the supernumerary sperm-nuclei, as reported for the pigeon.

In conclusion it may be said that polyspermy, accompanied by accessory cleavage, normally occurs in the hen's egg. If the number of accessory cleavage furrows may be taken as a general index to the number of accessory sperms entering the egg, it is evident that polyspermy in the hen is not nearly so great as in the pigeon.

J. THOS. PATTERSON

UNIVERSITY OF TEXAS

THE AMERICAN PHILOSOPHICAL SOCIETY

THE general meeting of the American Philosophical Society was held at the hall of the society on Independence Square, Philadelphia, on April 22, 23 and 24. The opening session began at two o'clock on Thursday, April 22, with President Keen in the chair, and morning and afternoon sessions were held on Friday and Saturday. Vice-president Michelson was in the chair during the session devoted to the papers in physics and Vice-president Scott at that at which the geological papers were considered. The evening of Friday, April 23, was devoted to a Darwin celebration commemorative of the centenary of Charles Darwin's birth and of the fiftieth anniversary of the publication of the "Origin of Species," at which addresses made by the Right Honorable James Bryce, the British Ambassador, on "Personal Reminiscences of Charles Darwin and of the Reception of the 'Origin of Species'"; by Professor George Lincoln Goodale, of Harvard, on "The Influence of Darwin on Natural Science," and by Professor George Stuart Fullerton, of Columbia, on "The Influence of Darwin on the Mental and Moral Sciences."

On Saturday afternoon there was a symposium on earthquakes at which papers were presented by Professor Edmund O. Hovey, Professor William H. Hobbs and by Professor Harry F. Reid. Aside from the three papers presented at the Darwin celebration on Friday evening, forty-four papers were read at the morning and afternoon sessions. A list of these papers with a brief summary of their contents follows:

The American-British Atlantic Fisheries Question: THOMAS WILLING BALCH, of Philadelphia.

This controversy, which is more than a century old, will shortly be submitted to The Hague International Court for settlement. As in the case of the Alaska frontier, where Canada's land claims grew greater with the passing of years, so in this fisheries dispute the position of America on the one hand and of Great Britain, Canada and Newfoundland on the other, is admirably summed up in the words with which the Russian plenipotentiary, Count Nesselrode, defined the positions and arguments of Russia and England when they were discussing the Russo-British American frontier: "Thus we wish to conserve and the English companies wish to acquire."

The Nation and the Waterways: Professor LEWIS M. HAUPT, of Philadelphia.

A philosophical discussion of the relation of the states and the national government in relation to the waterways of the country, in which it was pointed out that the lack of a proper distinction between local, state and national improvements has led the government to assume jurisdiction over all waterways and has thus retarded the symmetrical development of the trunk lines in connection with their feeders by the inability to systematically exclude all these works at the same time. The remedy must lie in the restriction of the governmental control to the strictly interstate waterways or trunk lines and principal harbors, while the states should charter, as in times past, local corporations to develop their own internal avenues of trade and power, as has been so satisfactorily done in relation to the overland highways of commerce and is still the practise in New York, Illinois, Massachusetts and other states.

Why America should Reexplore Wilkes Land: EDWIN SWIFT BALCH, of Philadelphia.

Lieutenant Charles Wilkes, U.S.N., first announced to the world in 1840 the existence of a great Antarctic continent, along whose shores he sailed for a distance of 1,500 miles. This coast is known as Wilkes Land. It has not been visited again. Sir James Clark Ross, R.N., Sir Clements R. Markham, ex-pres. R.G.S., and Captain Robert F. Scott, R.N., neither of whom has been there, declare emphatically that Wilkes Land does not exist and should be expurgated from the charts. It should, therefore, be looked on as a patriotic duty for America to verify Wilkes's discovery and get a more careful chart of its shores.

Many of the early discoveries in West Antarctica were made by American sealers, by Swain, Palmer, Pendleton, Morrell and Smiley. Now all their discoveries are being verified and enlarged by men of other nations. The same thing will happen with Wilkes's discoveries in East Antarctica, if America will not wake up. An expedition to verify Wilkes's discoveries would cost perhaps $100,000; and the best way to start it might be by forming an Antarctic committee, composed of representative scientists and explorers, who would take hold of and push this matter.

At the conclusion of the reading of Mr. Balch's paper the society adopted the following resolution, presented by Rear-Admiral Geo. W. Melville, Mr. Henry G. Bryant and Mr. E. S. Balch:

WHEREAS: The United States in former years made many brilliant discoveries in the Antarctic, including the continent of Antarctica by Charles Wilkes, and

WHEREAS: The United States have not taken any part in the recent scientific explorations of the South Polar region; therefore be it

Resolved, That the American Philosophical Society requests the cooperation of the scientific and geographical societies of the United States, to urge on the navy of the United States and through the general government, that it do make sufficient appropriations to fit a government vessel to thoroughly explore and survey the coast of Wilkes Land, and other parts of Antarctica.

The Volcanic Formation of Java: HENRY G. BRYANT, of Philadelphia.

An account of Mr. Bryant's explorations of the volcanic formations of the island of Java, illustrated by photographs taken by the author.

Machines and Engineering in the Renaissance and in Classical Antiquity: Professor CHRISTIAN HÜLSEN, of Rome.

A description of the methods and engines employed in moving great weights and performing other engineering feats that excite our admiration in the works of antiquity. A precursor of the automobile, a "walking chair," was described, that was operated by man power. The illustrations were drawn from contemporary sources, the earlier from monuments and carvings and the later from prints and drawings, and in many cases contemporary descriptions were cited.

The Brains of Two White Philosophers and of Two Obscure Negroes: Professor BURT G. WILDER, of Ithaca, N. Y.

The brains of Chauncey Wright and of James Edward Oliver were compared with the brains of two obscure negroes, one a mulatto, the other black. The very unusual gyral simplicity of Wright and the mulatto may have a physiologic significance. The black's brain is comparable with Oliver's and is considerably larger than that of a late prominent politician. These and other paradoxes exemplify the importance of securing a large collection of human brains, especially of educated people, for study and comparison.

In discussion, Professor E. A. Spitzka emphasized the need of more material and stated that the average negro brain is smaller than the average Caucasian.

Some Conditions Modifying the Interpretation of Human Brain Weight Records: DR. H. H. DONALDSON, of Philadelphia.

An account of the brain weight records that have been collected at the Wistar Institute of Anatomy. After the fifteenth year up to the fifty-fifth, the human brain loses slightly in weight and then more rapidly after that period. This slight loss in weight between the fifteenth and fifty-fifth years is attributed to the influence of those diseases which ultimately end in death.

New Evidences as to the Physical Basis of Heredity: Professor EDWIN GRANT CONKLIN, of Princeton.

Some Notes on the Modifications of Color in Plants: Professor HENRY KRAEMER, of Philadelphia.

The problem of modifying plants in a particular direction is attended with much difficulty, yet we see in nature numerous modifications which are due to the environment, or to external factors, although it is claimed by some modern evolutionists that none of the modifications due to food or to change of locality are permanent.

After reviewing the previous work on the control of color in plants, and enumerating the factors which influence the color in flowers, the author gave the results of his own experiments, which were begun in the autumn of 1904 and have been continued up to the present time. Various soils were experimented with, including an artificial soil, and sand to which a special nutrient was added. The chemicals used to modify the color principles were supplied to the plants in the form of solutions of varying strength, or added to the soil in the solid form, solution gradually taking place.

Results with Roses.—Probably the most striking result which the author obtained by the use of chemicals was the production of a red color in the petals of the white rose, Kaiserine. The red pigment occurred in the basal portion of the petals, and was produced in the flowers of plants which were supplied with potassium hydrate, potassium carbonate, calcium hydrate and lead acetate. It should be stated in this connection that the Kaiserine rose tends to yellowish but not to pink or red, and therefore the red color produced in the petals is a new character. Two explanations for its occurrence are suggested: (1) either the added chemical has reacted directly with a compound already present in the petals, or has induced the formation of an entirely new substance; or (2) the color substance formed in other parts of the plants, as in the leaves, has been transported to the petals through the influence of the chemical.

Results with Hydrangeas.—Since July, 1907, the author has been experimenting with the red-flowering form of *Hydrangea* (*H. Otaksa*). The following results have been obtained: Blue flowers were produced by plants growing in both sand and garden soil when supplied with the following chemicals: potassium and aluminum sulphate, aluminum sulphate and calcium hydrate. In those plants which were grown in sand and which were supplied with nutrient and potassium carbonate, blue flowers were also produced.

The flowers remained pink or red either when growing in soil or when growing in sand and fed with nutrient and supplied in addition with iron and ammonium sulphate, or lead acetate. In the plants fed with lead acetate the original color was considerably intensified.

In the case of the plants growing in soil and supplied with potassium carbonate there was no change in color, that is, the flowers remained pink, due probably to absorption of the chemical, while as noted above the flowers were changed to blue when growing in sand and supplied with this chemical.

Comparative Leaf Structure of the New Jersey Strand Plants: Professor JOHN W. HARSHBERGER, of Philadelphia.

Professor Harshberger classified the floral zones of the New Jersey coast district into four regions or "formations"; (1) the *beach*, (2) the *sand dune*, (3) the *thicket* and (4) the *salt meadow* formations. The character of the flora of each region was dwelt upon, and the leaf structures of the plants adapted to each habitat were described and illustrated. Professor Harshberger believed that studies of this character were necessary to indicate what kinds of plants would have to be grown, if an attempt to reclaim these regions were to be made.

The Composition of Chrysocolla: Professor HARRY F. KELLER, of Philadelphia.

Under this head are included various hydrated silicates of copper, which are amorphous and of rather indefinite composition. The color of these varies from green to blue. The author described a well-characterized variety from Chile, which forms enamel-like crusts of turquoise blue color, having the composition of an acid silicate with two molecules of water of crystallization. He expressed the opinion that the variation in color must be ascribed to the differences in the amount of water of crystallization, the blue varieties containing two molecules while the green varieties contain but one. He is also of the opinion that

many of the varieties analyzed contained admixtures of foreign substances.

The Chemical Work of the U. S. Geological Survey: FRANK WIGGLESWORTH CLARKE, of Washington.

An account of the admirable chemical work of the Geological Survey Laboratory, of which Professor Clarke is the chief, with a review of the more important results of this work.

Recent Work on the Physics of the Ether: PAUL R. HEYL, of Philadelphia.

Considerable interest has been taken of late in the question as to whether the ether is or is not a dispersive medium with regard to light. The work of the speaker, published about a year and a half ago, leads to the conclusion that any dispersion in the ether must be less than one part in 250,000. Since that time others have arrived at the conclusion that there exists a dispersive effect of much smaller magnitude, about one part in a million. There seems to be no doubt of the correctness of their observations, but it is not clear that it is to be attributed to a real dispersive effect in the ether. It is more likely that it is due to tidal phenomena in the atmosphere of the variable stars used as sources of light in the experiments.

The Effect of Bleaching Powder upon Bacterial Life in Water: Professor WILLIAM PITT MASON, of Troy, N. Y.

The extraordinary bactericidal effect of free chlorine or of bleaching powders used in minute quantities in drinking waters was described and it was suggested that an emergency plant for the manufacture of chlorine for this purpose should be attached to the municipal water supplies.

The Detonation of Gun Cotton: Professor CHARLES E. MUNROE, of Washington.

In the use of gun cotton in mines and torpedoes advantage is taken of the discovery of Mr. E. O. Brown that gun cotton which is completely saturated with water may be detonated by the detonation of dry gun cotton in direct contact with it used as a "priming charge," thus securing a large margin of safety for the naval vessels carrying the explosive. Wet gun cotton containing as high as 35 per cent. of water has been shown to be a more efficient rupturing and shattering explosive than dry gun cotton, but the question of how much water the discs of priming gun cotton may contain to be efficient was the object of the research detailed in this paper. The primer was in all cases fired by the service detonator containing 36 grains of mercuric fulminate. The results show that detonation of the entire charge was effected in every case in which the primer contained less than 12 per cent. of moisture, and occasionally was complete in cases where the moisture ran as high as 15 per cent. and therefore that such gun cotton primers containing not more than 12 per cent. of moisture, fired by means of a detonator containing 36 grains of mercuric fulminate may be relied upon to detonate wet gun cotton with which they are in contact.

The Toxodontia: Dr. W. J. SINCLAIR, of Princeton.

South American Fossil Cetacea: Dr. FREDERICK W. TRUE, of Washington.

Dr. True remarked that in connection with a revision of the fossil whales and porpoises of the United States he had had occasion to examine various specimens from Patagonia, including some belonging to Princeton University and to the American Museum of Natural History. Among the former, he found a skull of a new genus allied to the large porpoise of the Amazon River, known as the inia, but very much larger. The principal specimen from the American Museum of Natural History was a very finely preserved skull of a little-known genus, *Diochotichus*. This skull is remarkable in possessing large openings through the ethmoid plate, indicating that this porpoise, unlike modern forms, probably possessed a brain with an olfactory lobe and well-developed olfactory nerves, and hence, was endowed with a good sense of smell.

The Patagonian fossil cetaceans thus far known are from the provinces of Santa Cruz and Chubut, and are believed to belong to the Tertiary Epoch. At all events, some of the genera are the same as those found in the Miocene formations of Maryland, New Jersey and other Atlantic coast states.

Some of the Patagonian forms belong to families still represented in South America by living species. Others represent families no longer existing. The fossil fauna includes sperm whales, various forms allied to the inia, others allied to *Squalodon*, and at least one species of whalebone whales, allied to the finbacks, but no ziphioid, or beaked, whales nor any true dolphins have been found.

The Destruction of the Fresh-water Fauna of Western Pennsylvania: Dr. ARNOLD E. ORTMANN, of Pittsburg.

The fresh-water fauna forms part of our natural resources. That it has been injured and partly destroyed by the advance of civilization is well known, but it is not realized how far the destruction has advanced. Since a number of fresh-water creatures are of economical value

(fishes, mussels), and since all creatures belonging to the ecological community of the fresh-water are mutually dependent upon each other, it is very desirable that the causes which lead to the destruction of fresh-water life should be removed.

These causes are: direct extermination by man; pollution of the streams; and river "improvements," as, for instance, the building of dams. The pollution of the water is the most important cause, and, in western Pennsylvania, it is chiefly the coal mining and the oil industries which have contributed to the deterioration and destruction of the fresh-water fauna.

The extent to which this contamination of the waters has been carried in western Pennsylvania was clearly laid down on a map.

The Stratigraphic Position of the Oolitic Iron-ore at Bloomsburg, Pa.: GILBERT VAN INGEN, of Princeton.

A study of the so-called "Clinton fossil iron ores" in the vicinity of Bloomsburg, Pa., shows that these oolitic areas are above the Shawangunk grit and conglomerate which is Lower Salina in age, and that they are certainly above the Lower Salina. They contain an extensive fauna and the paleontological evidence points to a Salina age, at least post-Clinton and post-Niagara.

A Mechanical Device for the Tabulation of the Sums of Numerous Variable Functions: Professor ERNEST W. BROWN, of New Haven.

On Certain Generalizations of the Problem of Three Bodies: President EDGAR ODELL LOVETT, of Houston, Texas.

Penrose's Graphical Method of Orbit Computation: Mr. ERIC DOOLITTLE, of Philadelphia.

The method shows how, when the exact position of a moving comet or planet among the stars has been observed on three or more nights, the path of the body can be determined and also the position which the body will occupy as viewed from the earth at any desired time. But little computation and no knowledge of higher mathematics is necessary in applying the method which well illustrates the principles of more intricate methods and also enables the position of the body in the sky to be predicted with sufficient accuracy to render it easily found in a telescope at any time.

On the Remarkable Changes in the Tail of Comet C. 1908 (Morehouse), and on a Theory to Account for these Changes: Professor E. E. BARNARD, of Yerkes Observatory, Williams Bay, Wis.

Professor Barnard exhibited a remarkable series of photographs made with the photographic telescopes at the observatory, showing changes that occurred in the tail of this comet which appear to indicate resistance to the passage of the body through space. In discussion of the paper it was suggested that this resistance might arise from clouds of meteoric dust, too fine to be visibly appreciable, but which might still be dense enough to offer a resistance that would account for the changes in the form of the tail of the comet that were shown by the photographs.

The Past History of the Earth as Inferred from the Mode of Formation of the Solar System: Dr. T. J. J. SEE, of U. S. Naval Observatory, Mare Island, Cal.

Linear Resistance between Two Parallel Conducting Cylinders: Professor A. E. KENNELLY, Harvard University, Cambridge, Mass.

The equipotential surfaces perpendicular to the lines of flow between two equally and oppositely charged parallel wires of very small radii are cylinders whose axes are in the plane of and parallel to the charged wires. If any of these cylinders were made conducting and the charge on the wire within transferred to it, the lines of flow and equipotential surfaces on the outside would remain the same. Hence the resistance between any two such cylinders can be expressed in terms of their radii and the distance between their centers. The equivalent linear resistance between two equal cylinders or of one cylinder and the medium plane may be simply expressed as a product of its circumference and a function of its radii and the distance of its center from the plane.

Vacuum Effects in Electrical Discharge around a Right Angle in a Wire: Professor FRANCIS E. NIPHER, of St. Louis.

On the Ruling of Diffraction Gratings: Professor ALBERT A. MICHELSON, University of Chicago, Ill.

The paper gave a brief statement of the development of the grating, mentioning the ingenious wire grating of Fraunhofer, the improvements of Rutherford, and the magnificent gratings of Rowland. These were sufficient in their day, but problems connected with more recent researches like the Zeeman effect and phenomena of that nature demanded a much greater resolving power. In this connection it was pointed out that the important fact was not so much the number of rulings per inch as the total number of rulings, and that this greater number of rulings necessi-

tated a correspondingly greater degree of regularity—an accumulated error of one ruling in the entire number being fatal.

The ruling engine now set up in the Ryerson Laboratory gives this necessary increase in perfection of ruling, so that the spectra are almost free from ghosts and those of the higher orders can be used. The resolving power is proportional to the product of the total number of rulings into the order. A photograph of a part of the Hg spectrum was shown, in which the distance between two of the lines was only one two-thousandths of the distance between the Na D lines, and it was evident that lines separated by only one half of this distance would be distinctly resolved.

This ruling engine is the result of seven years' work. The large ten-inch gratings are ruled on metal to save the cutting edge of the diamond, and weigh about thirty pounds. The greater part of this weight is supported by a float in mercury, only a small part pressing upon the ways. It is moved along the ways by a screw with a large head working by fine teeth in an automatically actuated worm. This screw was made as perfect as possible by long, careful grinding and the remaining errors which are of the order of the one millionth part of an inch are automatically compensated for by a slight tangential motion of the worm. This motion is a function of the position of the nut, determined empirically.

On an Adjustment for a Plane Grating Similar to Rowland's for the Concave Grating: Professor CARL BARUS, assisted by M. Barus, of Providence.

By using two slides, one symmetrically normal to the other, and observing on both sides of the point of intersection, it is shown that many of the errors are eliminated by the symmetrical adjustments in question. The slide carrying the grating may be provided with a focusing lens in front, or again behind it, if the means are at hand for actuating the slit, which is not sharply in focus throughout the spectrum at a given time, on the plane of the eye piece carried by the second slide. It is thus best to use both lenses conjointly, the latter as a collimator and the former as an objective of the telescope in connection with the eye piece. The authors show that a centimeter scale parallel to the eye piece slide, with a vernier reading to millimeters, is sufficient to measure the wave lengths of light to few Angström units, while the wave lengths are throughout strictly proportional to the displacements along the scale. The errors of the three available methods and their counterparts are discussed in detail.

The Electrometer Method of Standardizing the Coronas of Cloudy Condensation: Professor CARL BARUS, of Providence.

The author makes use of Thomson's method of measuring the charge of an electron in terms of the velocity of the ions and their number. The latter, however, are determined from the angular diameter of the coronas of cloudy condensation, produced in a cylindrical fog chamber under given conditions of rapid exhaustion. By providing the chamber with a charged axial aluminum tube closed within, and charged or not with sealed tubelets of radium acting through the aluminum walls in virtue of its beta and gamma rays, the fog chamber becomes an electrical condenser with a variable ionization. The electrical current passing from core to the shell of the cylindrical condenser may therefore be simultaneously measured by a sensitive electrometer. If it be assumed that negative ions only are caught in the fog chamber used and if the author's earlier and independent results are employed for stating the nucleation value of the coronas, the following data are typical for the enormous ionizations produced:

Total number of ions per cub. cm. = 1,700,000, 385,000, 135,000.

Corresponding value of ten thousand million times the electrical charge = 4.4, 3.6, 3.9 electrostatic units.

The author discusses the results critically and shows that the displacement of ions during exhaustion is the most serious source of discrepancy. Again that in a house in which a continuous lighting circuit terminates, it is absolutely essential to determine both the positive and negative current in the condenser separately, as they are liable to be widely different. On the other hand, the effect of gamma rays on the outside of the fog chamber and of conduction currents is almost negligible for a well-installed apparatus.

The Electrometric Measurement of the Voltair Potential Difference between Two Conductors of a Condenser containing a Highly Ionized Medium: Professor CARL BARUS, of Providence.

Solar Activity and Terrestrial Magnetic Disturbances: DR. L. A. BAUER, of Washington.

This paper deals with the connections between the various manifestations of solar activity, *e. g.*, sun-spots, and the so-called magnetic storms which at times affect compass needles simultaneously all over the earth by several degrees and even cause

serious interruption in telegraph and cable lines, and are usually accompanied by fine auroral displays. One of the most severe of these magnetic storms was that of October 30–November 1, 1903, which was violent enough to derange the mariner's compass at certain places by as much as 3° and even was said to have caused a temporary suspension of the electric car lines in Zürich, Switzerland. The effect from this particular storm lasted for fully two months after its apparent subsidence, the earth's magnetic condition being *below* normal until towards the close of the year (1903).

Renewed interest has been shown by the recent discoveries of Professor Hale, director of the Carnegie Solar Observatory at Mount Wilson, Cal., viz., that sun-spots are centers of violent cyclones and that they are accompanied by powerful magnetic fields. But however intensely magnetic these whirling cyclones may be, a simple calculation shows that they are far too distant to appreciably affect our most sensitive magnetic instruments.

Yet the various curves exhibited show indisputably that some relation exists between solar activity, as evidenced, for example, by sun-spots, calcium flocculi, solar eruptions, prominences, etc., and the earth's magnetic fluctuations. The variations in the solar and the terrestrial magnetic phenomena follow each other closely. One of the most important of the conclusions drawn is, that an *increase in sun-spot activity is accompanied by a decrease in the earth's magnetization, or that the magnetization superposed on the earth's magnetic field during solar outbreaks is opposite to that of the earth's own field.*

It appears questionable whether the earth's magnetism ever settles down precisely to its former condition after the occurrence of a magnetic storm.

The facts are not yet sufficient to draw a definite conclusion whether solar activity and magnetic storms stand to each other as cause and effect or whether they are both effects of the same cause. The indications are, that during a period of intense solar activity, in some as yet unknown manner, considerable fluctuations are caused to take place in the electric field that we know from various facts exists in the regions above us. These varying electric currents in turn affect the magnetic needles on the earth's surface.

On the Hevelian Halo: Professor CHARLES S. HASTINGS, of New Haven, Conn.

The paper reviewed the various kinds of halos that have been described and the explanations that have been offered in regard to their origin. It had been assumed by writers on the subject that the snow crystals, which are in the form of plates or prisms, would fall with the plate or prism presenting the least resistance to the air. Thus, according to this idea, the hexagonal plates would fall edge on and the prism end on. This was shown to be incorrect and the contrary was the case, the plates and prisms could fall through the air with their longer dimensions horizontal. The plates would assume a horizontal position as well as the prisms. The halo was then caused by total internal reflection from the plates or prisms and not by surface reflection. Assuming these general positions for the long or short prisms (or plates) and total internal reflection the various types of halo that have been described could be explained, with the exception of the Hevelian halo. To explain this on the basis of total internal reflection it was necessary to assume pyramidal planes in the crystal of such an angle as to produce the 90 degree halo of this rare type.

The Effect of Temperature on the Absorption of Certain Solutions: Professor HARRY C. JONES, of Baltimore.

An account of experiments on the absorption spectra of certain solutions which Dr. Jones is carrying on under the auspices of the Carnegie Institution of Washington, D. C. Increase of temperature of the solution was found to alter the absorption spectra in the same way that they are changed by concentration of the solution.

The Specific Chemo-therapy of the Protozoal Diseases: Dr. SIMON FLEXNER, of the Rockefeller Institute for Medical Research, New York.

The Unsuspected Presence of Habit-forming Agents in Beverages and Medicines: Dr. LYMAN F. KEBLER, of Washington.

The paper considers the increased use of various habit-forming drugs. Attention is called to the fact that a large number of soft drinks contain not only a considerable amount of caffein, but in many instances small quantities of cocain. The presence of cocain has also been found in a considerable number of agents intended for the treatment of the tobacco habit. The presence of the same pernicious drug has been revealed in medicine used in the treatment of hay fever, asthma and for relieving pain resulting from dentition in infancy. The presence of morphine, opium, chloral hydrate, heroin and codein, singly or combined, has also been found in many other medicines, particularly those intended for the treatment of epilepsy, rheumatism, asthma, gastric troubles and ailments of infancy and childhood.

SYMPOSIUM ON EARTHQUAKES

Introduction, Classification, Discussion of Volcanic Earthquakes, Description, with Illustrations, of the Charleston, S. C., and Kingston, Jamaica, Disasters: Professor EDMUND O. HOVEY, New York.

The Present Status and the Outlook of Seismic Geology: Professor WILLIAM H. HOBBS, of Ann Arbor, Mich.

Conditions Leading to Tectonic Earthquakes—Instruments used in the Study of Earthquakes—Suggestions for a National Seismological Bureau: Professor HARRY F. REID, of Baltimore.

Professor Hovey's paper served as an introduction to the subject. The ideas in regard to the cause of earthquakes were considered, especial attention being given to a discussion of volcanic earthquakes. Professor Hovey described the Charleston and Kingston earthquakes and illustrated his description by lantern slides. At the conclusion of his paper he exhibited a series of views of the Messina earthquake of December, 1908.

Professor W. H. Hobbs spoke of the manner in which the subject of seismology had been retarded by the publications of Robert Mallet, who advocated the idea that the shock originates at some point underground called the seismic focus or centrum, and from which center elastic waves are propagated in all directions. Professor Hobbs pointed out the fact that the "centrum" as determined by the method of Mallet was at best a line and practically had no existence. He explained the production of earthquakes by the shifting of segments of the crust along already existing fissures due to geotectonic movements, and insisted upon the tectonic origin of earthquakes. Volcanic activity and earthquake activity may be associated, as volcanoes are located along lines of fissure in the crust. Release of strain by shifting of the crust blocks, accompanied by earthquakes, as has been going on in the earthquake regions surrounding the Pacific Ocean in the last few years, probably produces in such a region an establishment of approximate equilibrium so that earthquakes may not be so severe for some time. The probability of earthquakes occurring in a given region may be tentatively predicted by a study of such crustal adjustment, but such predictions must be considered as tentative only. The upward or downward movement of the surface during earthquakes may be considerable, producing raised beaches, as has recently occurred in the Alaskan Islands. Along some coast lines the evidence of such movement is to be seen in the raising of sea caves, and also the undercut portions of sea-cliffs, above the water level. As these movements involve many feet of elevation during an earthquake, perhaps the ideas of Lyell on the rate of changes of level of the land and sea may have to be modified.

Professor Harry Fielding Reid considered three phases of the subject: (*a*) conditions leading to tectonic earthquakes, (*b*) instruments used in the study of earthquakes, (*c*) suggestions for a national seismological bureau.

(*a*) The rocks have the properties of elastic substances and can only break after they have been deformed by the action of external forces. When they are strained beyond their strength a break occurs and the rocks return to an unstrained position, but it is only in the general neighborhood of the rupture that any distinct displacement takes place at the time of the earthquake.

(*b*) Earlier investigators attempted to obtain a "steady point"; that is, a point which would remain at rest when the earth vibrated under the earthquake disturbances. This, however, is impracticable. All earthquake instruments must have a proper period of vibration and when the disturbance affects them the resulting record is a combination of the movement of the earth and the movement of the instrument. When the period of vibration approaches that of the instrument, the latter has a very large swing and therefore the records unduly magnify special vibrations. This can be avoided by introducing strong damping. The different forms of instruments were briefly noticed.

(*c*) The work of a national bureau would be very varied. It would require the collection of data regarding all felt earthquakes, and a geological examination, in special cases, of the regions where earthquakes occur. The instrumental records from the whole country should also be collected and studied to throw light on the nature of the earth's interior, and to discover the centers of earthquake disturbances in the surrounding oceans. This would require the general cooperation of many departments of the government and could probably be best undertaken by the Smithsonian Institution.

At the conclusion of the discussion following the symposium Professor Hobbs presented the following resolutions, which were unanimously adopted:

WHEREAS: Earthquakes have been the cause of

great loss of life and property within the territory of the United States and its possessions, as well as other countries; and

WHEREAS: It is only through the scientific investigation of the phenomena that there is hope of discovering the laws which govern them, so as to predict their occurrences and to reduce the danger to life and property; and

WHEREAS: Such investigations can be successfully conducted only with the support of the general government, be it therefore

Resolved, That this society urge upon Congress the establishment of a national bureau of seismology, and suggest that this bureau be organized under the Smithsonian Institution with the active cooperation of the other scientific departments of the government, and that this bureau be charged with the following duties: (*a*) the collection of seismological data, (*b*) the establishment of observing stations, (*c*) the organization of an expeditionary corps for the investigation of special earthquakes and volcanic eruptions in any part of the world, (*d*) the study and investigation of special earthquake regions within the national domain, and

Resolved, That copies of these resolutions be transmitted to the president, the speaker of the house of representatives, to the president of the senate and to the secretary of the Smithsonian Institution.

The Evolution of the City of Rome from its Origin to the Gallic Catastrophe: Professor JESSE B. CARTER, of Rome, Italy.

An attempt to sketch in its outlines the development of the city of Rome from its origin to the Gallic catastrophe. The original people lived in little communities upon the hilltops, each community surrounded by a circular wall or stockade. The geological character of the campagna and its topography produced a number of elevations admirably adapted for such settlements. All of these little hilltop towns must have been very similar in population and customs and no one was probably a leader among them. Their consolidation into a city is assigned to the influence of an invasion by the Etruscans who conquered these hill towns, and enclosed them along with their intervening valleys with one wall. Some villages remained without the wall, as suburbs to be afterwards incorporated in the city; such were the Aventine region and the Campus Martius. The city had then outgrown its original dimensions and was no longer all within walls, which accounts for the ease with which it was captured by the Gauls in 390 B.C. With the capture of the city by the Gauls Rome enters upon her period of inviolability for almost eight hundred years and the thought suggests itself irresistibly that the reputation for inviolability thus gained may have been a large factor in preserving her inviolate. Even in their early days the city began to be "that so holy spot, this very Rome."

On the Extent and Number of the Indo-European Peoples: Professor MAURICE BLOOMFIELD, of Baltimore.

The Burning Bush and the Origin of Judaism: Professor PAUL HAUPT, of Baltimore.

The Israelites probably never saw Egypt. The so-called Israelites who were in Egypt were the descendants of Esau, the Edomites. The burning bush was explained as the shrubbery on the heights of a volcano, lighted up at night by the glow of the incandescent lava. The story of the pillar of cloud by day and pillar of fire by night was not that it hung over the tabernacle but over Mount Sinai, the cloud of steam from the active volcano was the "pillar of cloud by day and the pillar of fire by night." The myths in regard to the destruction of Jericho and of Sodom and Gomorrah were attributed to the effect of earthquakes.

Magic and Religion: Professor EDWARD W. HOPKINS, of New Haven.

Milton's Confession of Faith: The Identity of Religious Belief between Milton and George Fox: ALDEN SAMPSON, of Haverford, Pa.

J. J. Rousseau, a Precursor of Modern Pragmatism: Professor ALBERT SCHNIZ, of Bryn Mawr, Pa.

At the Darwin commemorative meeting, after the presentation of the three addresses attention was called to the fact that there were two members of the American Philosophical Society still living in England who were friends of Charles Darwin—Sir Joseph Dalton Hooker and Dr. Alfred Russel Wallace—and on motion it was unanimously resolved that the society should cable to them its greetings and congratulations on the general acceptance of the views in the elaboration and promulgation of which they had taken such an effective part.

Early in the day a telegram was sent to Vice-president Simon Newcomb conveying to him the society's good wishes and greeting and their regret that he could not be present at the meeting.

The meeting was largely attended by members from various parts of the country and was regarded as most successful both from the point of

view of the quality of the papers read and the number and broadly representative character of the members who took part in it.

The sessions closed with a dinner at the Bellevue-Stratford, on Saturday evening, April 24, at which about one hundred members were present and at which the speakers were: President Patton, of Princeton; the British Ambassador, Mr. Bryce; President Pritchett, of the Carnegie Foundation; President-elect Lowell, of Harvard, and President Keen, of the American Philosophical Society.

The annual election of members held at the executive session on Saturday, April 24, resulted in the election of the following candidates:

Residents of the United States.—Louis A. Bauer, Ph.D. (Berlin), Washington, D. C.; Marston Taylor Bogert, New York; Hermon Carey Bumpus, Ph.D., New York City; Alexis Carrel, M.D., New York City; Edwin Brant Frost, Williams Bay, Wis.; Robert Almer Harper, Ph.D., Madison, Wis.; William Herbert Hobbs, Ph.D., Ann Arbor, Mich.; A. V. Williams Jackson, Ph.D., LL.D., Yonkers, N. Y.; John Frederick Lewis, Philadelphia; Abbott Lawrence Lowell, Boston, Mass.; William Romaine Newbold, Ph.D., Philadelphia; Charles Bingham Penrose, M.D., Ph.D., Philadelphia; William Howard Taft, Washington; Charles Richard Van Hise, M.S., LL.D., Madison, Wis.; Victor Clarence Vaughan, M.D., Sc.D., LL.D., Ann Arbor, Mich.

Foreign Residents.—Francis Darwin, M.A., F.R.S., Cambridge, Eng.; Hermann Diels, Ph.D., Berlin; Emil Fischer, Ph.D., M.D., Berlin; Friedrich Kohlrausch, Ph.D., Marburg; Wilhelm F. Ph. Pfeffer, Ph.D., Leipzig.

SOCIETIES AND ACADEMIES

THE ACADEMY OF SCIENCE OF ST. LOUIS

On the evening of Monday, March 1, the regular meeting of the Academy of Science of St. Louis was held at the Academy Building, the feature of the program being a paper, read by Mr. Julius Hurter. The subject of the discourse, which had been compiled by Mr. Hurter and Mr. John K. Strecker, Jr., was "The Amphibians and Reptiles of Arkansas."

After stating that up to the present time definite records are obtainable from only 15 of the 75 counties of Arkansas, Mr. Hurter recorded the facts that 100 species of reptiles and amphibians have been reported from Arkansas, and 90 from Missouri. Thirteen of the Arkansas species are not known to occur in Missouri, and nineteen are not found in eastern Texas. Most of the species are eastern and southeastern forms which find their western limit in Arkansas and the eastern half of Louisiana. Another interesting fact brought out was this—that of the 71 species occurring in both Arkansas and the eastern half of Texas, 63 are also found in the state of Missouri. Mr. Hurter showed numerous specimens in illustration of his paper, and also the blind salamanders of the world: *Proteus anguinus* (European blind salamander), *Typhlotriton spelæus* (Missouri) and *Typhlomolge rathbuni* (Texas).

At this meeting, on proper motion, duly seconded and unanimously carried, the following memorial was adopted as expressing the views of the academy; and copies were ordered sent to the speaker of the house of representatives, the president of the senate, and the gentlemen who represent Missouri in both branches of the present Congress:

"The Academy of Science of Saint Louis, an organization equally interested in the preservation and the proper and consistent utilization of the gifts of nature, respectfully urges on the Congress of the United States the desirability of promptly passing the House Joint Resolution now under consideration as a means of continuing the provisions of the Burton Bill, limiting the diversion of water from Niagara Falls, until equally effective but more permanent protection of the Falls shall be secured by adequate legislative or executive action."

The program of the meeting of the Academy of Science of St. Louis which occurred on March 15 was a paper by Mr. Otto Widmann on "The Birds of the Missouri Botanical Garden." In twenty visits to the garden during the summer of 1908, Mr. Widmann noted forty species of birds breeding there, and six species which were more or less regular visitors from near-by breeding grounds. And, besides these, there were scores of transient visitants during the migratory seasons. The breeders are the bob-white, mourning-dove, screech owl, yellow-billed cuckoo, black-billed cuckoo, red-headed woodpecker, northern flicker, chimney swift, kingbird, great crested flycatcher, wood pewee, Traill's flycatcher, blue jay, crow, cowbird, red-winged blackbird, meadow lark, orchard oriole, Baltimore oriole, bronzed grackle, goldfinch, English sparrow, English tree sparrow, chipping sparrow, song sparrow, towhee, cardinal, rose-breasted grosbeak, indigo bunting, warbling vireo, Bell's vireo, yellow warbler, yellow-throat, yellow-breasted chat, mockingbird, catbird, brown thrasher, house wren, wood thrush and robin.

Of the whole bird population of the garden, only four species are permanent residents. And these are the bob-white, flicker, mockingbird and redbird. The regular visitors are the sparrow-hawk, king-fisher, night-hawk, humming-bird, purple-martin and cedar waxwing. The numerous hedges of dense shrubbery harbor Bell's vireo, yellow warbler, Maryland yellow-throat, chat, Traill's flycatcher and the indigo bunting. In the arboretum are found the crested flycatcher, wood pewee, wood thrush, cuckoos and the gentle mourning doves. The meadow has attracted quails and meadow-larks. The ripening mulberries are an attraction for flocks of cedar birds in early June, and the many beautiful flowers charm numberless hummingbirds later in the summer.

Thirty or more species of birds were on exhibition to illustrate Mr. Widmann's paper.

At this meeting the following resolution was adopted: "On the recommendation of its entomological section, and with approval of its council, the Academy of Science of St. Louis, on duly seconded and passed motion at its regular meeting of the fifteenth of March, 1909, respectfully urges on the members of the General Assembly of the State of Missouri, the importance of passing House Bill No. 575, and Senate Bill No. 197, providing the adequate inspection of nursery stock. At the present moment the entire orchard and nursery industry of the state is imperiled by a threatened introduction of the dreaded brown-tail moth, in the bare restriction of which New England has for years waged a costly warfare. Nothing but adequately planned and efficiently administered state inspection can protect this important industry of Missouri in the present or in future crises."

ON April 5, the Academy of Science of St. Louis met to hear a paper presented by Prof. Whinthrop Holt Chenery, of Washington University, on "The Relation of the Physiography of the Iberian Peninsula to the Development of the Spanish and Portuguese Peoples." Mr. Chenery considered the distinguishing features of the peninsula—topographic, geological and climatic—and their significance as determining factors in the historical evolution of the peoples. In particular he showed that the chief occupations of the inhabitants, ever since prehistoric times, have been determined by the physical character of the country; and that the long-continued prevalence of these occupations has produced widely divergent types of people.

The lecture was fully illustrated, and insistence was laid upon the importance of the study of physical environment to the understanding of the Spanish-Portuguese history.

W. E. MCCOURT,
Recording Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 664th meeting was held April 10, 1909, Vice-President Wead in the chair. Two papers were read.

An Approximate Method of Analysis of E.M.F. Waves: P. C. AGNEW.

A knowledge of the impurities present in the E.M.F. wave given by a generator is required in many engineering and physical problems. While a large number of methods have been devised for the analysis of such E.M.F. waves, those methods which give quantitative results require highly specialized and expensive apparatus. The experiments described were undertaken to determine if it is possible to obtain reliable results by the use of condensers and portable indicating instruments only.

For the same effective voltage, a distorted wave will pass more current into a condenser than will a pure sine wave. We ought, then, to be able to use this fact to determine the amount of impurities present in a given wave. Obviously a greater accuracy can be attained if we make the analysis depend on bridge values of resistance, inductance and capacity, and so make it independent of the absolute calibrations of the voltmeter and ammeter used. This may be accomplished by replacing the condenser by a resistance and adjusting to give the same readings of ammeter and voltmeter. We may consider that each component of voltage, e_n, causes the corresponding component of current, i_n, to flow. The square of the effective value of current indicated by the ammeter is equal to the sum of the squares of the components. If in the case of the presence of the nth harmonic only, C represents the capacity, L the inductance, r the resistance, and if p is 2π times the frequency,

$$I^2 = \frac{e_1^2}{r^2 + (pL - 1/pC)^2} + \frac{e_n^2}{r^2 + (npL - 1/npC)^2}.$$

Now on removing the condenser and increasing the resistance to R, we have, for the same readings of voltmeter and ammeter,

$$I^2 = \frac{e_1^2}{R^2 + p^2L^2} + \frac{e_n^2}{R^2 + n^2p^2L^2}.$$

From these relations, we get the ratio of the harmonic to the fundamental E.M.F.,

$$\frac{e_n}{e_1}=\frac{\sqrt{1/a_3-1/a_1}}{\sqrt{1/a_2-1/a_4}},$$

where a_1, a_2, a_3, a_4, have been written for the four impedances in the denominators above.

While theoretically the method may be extended to any number of harmonics, it is practically limited to two by the accuracy of readings and by the labor of computation. Experiments in the analysis of waves built up by combining the E.M.F.'s of different machines, and also by the analysis of E.M.F. waves of single generators, show that the method is capable of an accuracy of two or three per cent. of the fundamental.

The method has the disadvantages of giving no information of the phase relations, and of not readily lending itself to the analysis of current waves. The advantages are that it requires no special apparatus; direct access to the generator, or the use of synchronous motor, is not necessary; and the accuracy is better than that of an oscillograph, though not equal to that of a curve tracer.

The Accurate Analysis of Alternating Current Waves: F. W. GROVER.

With the rapid development, in recent years, of methods and apparatus for the tracing of alternating current waves, the question of the convenient analysis of the curves obtained has become increasingly important. Although the well-known method of Fourier is the most direct and accurate, its employment seems to be quite generally regarded as too laborious for general use. This is evidenced by the appearance of a number of graphical and planimetrical methods, among which may be mentioned those of Clifford, Fischer-Hinnen, and Houston and Kennelly. All these modes of procedure, however, labor under the disadvantage, inherent in all graphical methods, of inaccuracy where small quantities are involved, without any saving of time over that required to derive the values of an equal number of harmonics by the Fournier analysis if the calculation be suitably arranged.

In 1897 Rosa simplified the calculation by the use of a table from which the required products of the ordinates by the sines of the angles could be taken directly from a table. Using this, all the odd harmonics up to and including the 15th can be obtained in a little over an hour.

S. P. Thompson[1] showed that the work could be still further shortened, (1) by grouping together those ordinates which are to be multiplied by the sines of the same angle, and (2) by dividing the half wave into an even number n of equal parts, when the products divide themselves into complementary groups, so that the kth and $(n-k)$th harmonics are found, respectively, by adding and subtracting the sums of two groups of products. He gave the complete scheme of calculation for the two cases, $n=6$ and $n=12$. The whole analysis in the former case may be carried through in ten minutes or even less.

The electromotive force waves of alternators with slotted armatures, however, often contain the higher harmonics to an appreciable extent, and these may greatly distort the form of the current wave in circuits containing capacity. The speaker has therefore developed the scheme of calculation for the case of 18 ordinates and has prepared a table to facilitate the multiplications. Such a table need include the ordinates up to 100 only, the fractional parts being found from the same table by shifting the decimal point. Using this method the amplitudes of all the harmonics up to and including the 17th may be determined in about half an hour with an accuracy and ease not attainable by any graphical method.

[1] *Electrician*, May 5, 1905.

R. L. FARIS,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 458th meeting was held April 3, 1909, with President Palmer in the chair. Lantern slides made by a novel application of well-known methods were shown upon the screen by Mr. A. A. Doolittle. The silver is thoroughly removed from plates, leaving only the gelatin film; from old, unused or undeveloped plates by the usual hypo bath, and from poor or waste negatives by the reducing process with ferri-cyanide. On immersing the thoroughly washed plate in blue print solution for five minutes and subsequent drying in the dark, they may be printed upon by contact with negatives in the usual manner. They give clear high lights and contrasting effects, desirable qualities in lantern slides or transparencies. The color is a pleasing semi-translucent blue. The method is simple and can be used by the inexperienced. Beautiful window transparencies are similarly made.

The following communications were presented:

Classification of the True Fishes: THEODORE GILL.

The speaker restricted the class Pisces to the true fishes or Teleostomes, as he had done since 1873. Two of the best zoologists of Europe (Hubrecht, of Holland, and Regan, of the British Museum) have recently come to the same con-

clusion. Regan has also recently (January, 1909) published on "The Classification of Teleostean Fishes" and admitted four subclasses of Teleostomes and 31 orders of Teleosts. The four subclasses are the same as four of those recognized by the speaker in 1896; a fifth then admitted in deference to the general sentiment at that time (Hyoganoidea) may now be suppressed. Remarks were made on the contrast between the orders recognized till past the middle of the last century and those now admitted by Mr. Regan and the speaker. Praise was accorded to Regan for his work, but the speaker was disposed to dissent from him as to certain groups and presented the following list of orders. Those named without synonyms are the same as Mr. Regan's; the synonyms added after many are the names given by Regan. It was especially insisted upon that the list was only provisional and tentative and that no significance need be attached to the exact position or sequence of some of the orders. The author is now employed in further studies of the osteology.

Our knowledge of the extinct types is in such an unsatisfactory condition that the present list is restricted to the living forms.

Class Pisces

Subclass Dipnoi or Dipneusti.
- Order Sirenoidei.

Subclass Crossopterygii.
- Order Semæopteri or Cladistia.

Subclass Chondroganoidei.
- Order Chondrostei.
- Order Selachostomi.

Subclass Teleostei.
- Order Rhomboganoidei or Ginglymodi.
- Order Cycloganoidei or Protospondyli.
- Order Malacopterygii or Isospondyli.
- Order Iniomi.
- Order Scyphophori (S. O. Mormyroidei).
- Order Plectospondyli (S. O. Cyprinoidei).
- Order Nematognathi (S. O. Siluroidei).
- Order Symbranchii.
- Order Carencheli.
- Order Apodes.
- Order Lyomeri.
- Order Opisthomi.
- Order Heteromi.
- Order Lyopomi (Heteromi pt.).
- Order Xenomi (S. O. Dallioidei).
- Order Haplomi (Microcyprini).
- Order Synentognathi.
- Order Salmoperces.
- Order Percesoces.
- Order Rhegnopteri (S. O. Polynemoidei).
- Order Acanthopterygii (Labyrinthici + Malacichthyes + Anacanthini + Allotriognathi pt. + Berycomorphi + Heterosomata + Percomorphi + Batrachoidei).
- Order Hemibranchii (Thoracostei + Solenichthyes pt.).
- Order Hypostomides.
- Order Lophobranchii (Solenichthyes Solenostomoidei and Syngnathoidei).
- Order Discocephali.
- Order Chondrobrachii.
- Order Tæniosomi (S. O. Trachypteroidei).
- Order Atelaxia (S. O. Stylophoroidei).
- Order Xenopterygii or Xenopteri.
- Order Plectognathi.
- Order Pediculati.

The Guano-birds of Peru: ROBERT E. COKER. (Illustrated with lantern slides.)

The chief guano-producing birds in order of importance are—a cormorant (*Phalacrocorax bougainvillei* Less.), the pelican (*Pelecanus molinæ* (Molina) Gr.) and a gannet (*Sula variegata* Tsch.). A small petrel (*Halodroma garnoti* Less.) has some significance, and, if earlier accounts are accepted, it was formerly much more abundant and important. The penguin (*Spheniscus humboldti* Meyen) was reputed to be commercially important a few decades ago. Other interesting birds were observed on and near the islands.

The pelican has suffered most from the disturbance incident to the extraction of guano from the rookeries. The bird has been practically eliminated from the small islands of the southern region, but still breeds in great numbers on the larger islands of the north. A colony of pelicans, between twenty and forty thousand in number, was observed on the Lobos de Afuera Islands. Since 1906 the Peruvian government has enforced a "closed" season of five months annually, but it is expected that a more adequate plan of rotation will be adopted, so that the birds on certain islands may be undisturbed for periods of years. In partial adoption of this plan, the South Island of the Chincha group has been kept "closed" for nearly three years. It is estimated that, by the expiration of the three years, a deposit of twenty thousand tons will have accumulated upon this island.

THE 459th meeting was held April 17, 1909, in Hubbard Memorial Hall, with President Palmer in the chair. The evening was devoted to a lecture by Mr. Charles Sheldon, of New York, on "Experiences with Big Game in the Mt. McKinley Region, Alaska," illustrated by a large number of stereopticon views of the country and of mountain sheep, caribou, moose, lynx, bear and ptarmigan.

M. C. MARSH,
Recording Secretary

SCIENCE

FRIDAY, MAY 28, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

RACE PROBLEMS IN AMERICA[1]

THE development of the American nation through amalgamation of diverse European nationalities and the ever-increasing heterogeneity of the component elements of four people have called attention to the anthropological and biological problems involved in this process.

I propose to discuss here these problems with a view of making clear the hypothetical character of many of the generally accepted assumptions. It will be our object to attempt a formulation of the problems, and to outline certain directions of inquiry, that promise a solution of the questions involved, that, at the present time, can not be answered with scientific accuracy. It is disappointing that we have to accept this critical attitude, because the events of our daily life bring before our eyes constantly the grave issues that are based on the presence of distinct types of man in our country, and on the continued influx of heterogeneous nationalities from Europe. Under the pressure of these events, we seem to be called upon to formulate definite answers to questions that require the most painstaking and unbiased investigation. The more urgent the demand for final conclusions, the more needed is a critical examination of the phenomena and of the available methods of solution.

Let us first represent to our minds the facts relating to the origins of our nation. When British immigrants first flocked to the Atlantic coast of North America, they found a continent inhabited by Indians. The population of the country was thin,

[1] Address of the vice-president and chairman of Section H, American Association for the Advancement of Science, Baltimore, 1908.

and vanished comparatively rapidly before the influx of the more numerous Europeans. The settlement of the Dutch on the Hudson, of the Germans in Pennsylvania, not to speak of other nationalities, is familiar to all of us. We know that the foundations of our modern state were laid by Spaniards in the Southwest, by French in the Mississippi Basin and in the region of the Great Lakes, but that the British immigration far outnumbered that of other nationalities. In the composition of our people, the indigenous element has never played an important rôle, except for very short periods. In regions where the settlement progressed for a long time entirely by the immigration of unmarried males of the white race, families of mixed blood have been of some importance during the period of gradual development, but they have never become sufficiently numerous in any populous part of the United States to be considered as an important element in our population. Without any doubt, Indian blood flows in the veins of quite a number of our people, but the proportion is so insignificant that it may well be disregarded.

Much more important has been the introduction of the negro, whose numbers have increased many fold so that they form now about one eighth of our whole nation. For a certain length of time the immigration of Asiatic nations seemed likely to become of importance in the development of our country, but the political events of recent years have tended to decrease their immediate importance considerably; although we do not venture to predict that the relation of Asiatics and white Americans may not become a most important problem in the future. These facts, however, are familiar to all of us and stand out clearly to our minds.

More recent is the problem of the immigration of people representing all the nationalities of Europe, western Asia and northern Africa. While until late in the second half of the nineteenth century the immigrants consisted almost entirely of people of northwestern Europe, natives of Great Britain, Scandinavia, Germany, Switzerland, Holland, Belgium and France, the composition of the immigrant masses has changed completely since that time. With the economic development of Germany, German immigration has dwindled down; while at the same time Italians, the various Slavic peoples of Austria, Russia and the Balkan Peninsula, Hungarians, Roumanians, east European Hebrews, not to mention the numerous other nationalities, have arrived in ever-increasing numbers. There is no doubt that these people of eastern and southern Europe represent a physical type distinct from the physical type of northwestern Europe; and it is clear, even to the most casual observer, that their present social standards differ fundamentally from our own. Since the number of new arrivals may be counted in normal years by hundreds of thousands, the question may well be asked, What will be the result of this influx of types distinct from our own, if it is to continue for a considerable length of time?

It is often claimed that the phenomenon of mixture presented in the United States is unique; that a similar intermixture has never occurred before in the world's history; and that our nation is destined to become what some writers choose to term a "mongrel" nation in a sense that has never been equaled anywhere.

When we try to analyze the phenomena in greater detail, and in the light of our knowledge of conditions in Europe as well as in other continents, this view does not seem to me tenable. In speaking of European types, we are accustomed to consider them as, comparatively speaking, pure stocks. It is easy to show that this view

is erroneous. It is only necessary to look at a map illustrating the racial types of any European country—like Italy, for instance—to see that local divergence is the characteristic feature, uniformity of type the exception. Thus Dr. Ridolfo Livi, in his fundamental investigations on the anthropology of Italy, has shown that the types of the extreme north and of the extreme south are quite distinct—the former tall, short-headed, with a considerable sprinkling of blond and blue-eyed individuals; the latter short, long-headed and remarkably dark. The transition from one type to the other is, on the whole, quite gradual, but, like isolated islands, distinct types occur here and there. The region of Lucca in Tuscany and the district of Naples are examples of this kind, which may be explained as due to the survival of an older stock, to the intrusion of new types, or to a peculiar influence of environment.

Historical evidence is quite in accord with the results derived from the investigation of the distribution of modern types. In the earliest times we find on the peninsula of Italy groups of heterogeneous people, the linguistic relationships of many of which have remained obscure up to the present time. From the earliest prehistoric times on, we see wave after wave of people invading Italy from the north. Very early Greeks settled in the greater part of southern Italy and Phœnician influence was well established on the west coast of the peninsula. A lively intercourse existed between Italy and northern Africa. Slaves of Berber blood were imported and have left their traces. Slave trade continued to bring new blood into the country until quite recent times, and Livi believes that he can trace the type of Crimean slaves who were introduced late in the Middle Ages in the region of Venice. In the course of the centuries, the migrations of Celtic and Teutonic tribes, the conquests of the Normans, the contact with Africa, have added their share to the mixture of people on the Italian peninsula.

The fates of other parts of Europe were no less diversified. The Pyrenæan Peninsula, which at present seems to be one of the most isolated parts of Europe, had a most checkered history. The earliest inhabitants of whom we know were presumably related to the Basques of the Pyrenees. These were subjected to Oriental influences in the Pre-Mycenæan period, to Punic influences, to Celtic invasions, Roman colonization, Teutonic invasions, the Moorish conquest, and later on to the peculiar selective process that accompanied the driving-out of the Moors and the Jews.

England was not exempt from vicissitudes of this kind. It seems plausible that at a very early period the type which is now found principally in Wales and in some parts of Ireland occupied the greater portion of the islands. It was swamped by successive waves of Celtic, Roman and Anglo-Saxon migration. Thus we find change everywhere.

The history of the migrations of the Goths, the invasions of the Huns, who in the short interval of one century moved their habitations from the borders of China into the very center of Europe, are proofs of the enormous changes in population that have taken place in early times.

Slow colonization has also brought about fundamental changes in blood as well as in diffusion of languages and cultures. Perhaps the most striking recent example of this change is presented by the gradual Germanization of the region east of the Elbe River, where, after the Teutonic migrations, people speaking Slavic languages had settled. The gradual absorption of Celtic communities, of the Basque, in ancient times the great Roman colonization,

and later the Arab conquest of north Africa, are examples of similar processes.

Intermixture in early times was not by any means confined to peoples which, although diverse in language and culture, were of fairly uniform type. On the contrary, the most diverse types of southern Europe, northern Europe, eastern Europe and western Europe, not to mention the elements which poured into Europe from Asia and Africa, have been participants in this long-continued intermixture.

There is, however, one fundamental difference in regard to the early European migrations and the modern trans-Atlantic migration. On the whole, the former took place at a period when the density of population was, comparatively speaking, small. There is no doubt that the number of individuals concerned in the formation of the modern types of Great Britain were comparatively few as compared with the millions who come together to form a new nation in the United States; and it is obvious that the process of amalgamation which takes place in communities that must be counted by millions differs in character from the process of amalgamation that takes place in communities that may be counted by thousands. Setting aside social barriers, which in early times as well as now undoubtedly tended to keep intermingling peoples separate, it would seem that in the more populous communities of modern times a greater permanence of the single combining elements might occur, owing to their larger numbers, which make the opportunities for segregation more favorable.

Among the smaller communities the process of amalgamation must have been an exceedingly rapid one. After the social distinctions have once been obliterated, pure descendants of one of the component types decrease greatly in number, and the fourth generation of a people consisting originally of distinct elements will be almost homogeneous. I shall revert to this phenomenon later on.

It might be objected to this point of view, that the very diversity of local types in Europe proves the homogeneity of race types—as, for instance, of the northwestern European type, the Mediterranean type, the east European type, or the Alpine type; but it must be remembered that we have historical proof of the process of mixture, and that the relative number of component elements is sufficient to account for the present conditions.

I think we may dismiss the assumption of the existence of a pure type in any part of Europe, and of a process of mongrelization in America different from anything that has taken place for thousands of years in Europe. Neither are we right in assuming that the phenomenon is one of a more rapid intermixture than the one prevailing in olden times. The difference is based essentially in the masses of individuals concerned in the process.

If we confine our consideration for the present to the intermixture of European types in America, I think it will be clear, from what has been said before, that the concern that is felt by many in regard to the continuance of racial purity of our nation is to a great extent imaginary. The history of Europe proves that there has been no racial purity anywhere for exceedingly long periods, neither has the continued intermixture of European types shown any degrading effect upon any of the European nationalities. It would be just as easy to prove that those nations that have been least disturbed have lacked the stimulus to further advance and have passed through periods of quiescence. The history of Spain might be interpreted as an instance of an occurrence of this kind.

The question as to the actual effects of intermixture will not, however, be an-

swered by a generalized historical treatment such as we have attempted here. The advocates of the theory of a degradation of type by the influx of so-called "lower" types will not be silenced by reference to earlier mixtures in Europe, the course of which can no longer be traced in actual detail for we do not know to what extent actual intermarriages have taken place, and what the development of families of mixed descent as compared with those of pure descent has been. It seems necessary that the problem should be approached from a biological standpoint. It seemed well, however, to gain first a clearer view of the historical relations of our problem. A knowledge of the events of the past tends to lay our apprehensions, that make the problem exciting, and which for this reason fill the observer with a strong bias for the results which he fears or desires.

Two questions stand out prominently in the study of the physical characteristics of the immigrant population. The first is the question of the influence of selection and environment in the migration from Europe to America. The second is the question of the influence of intermixture. A beginning of a thorough study of the former question was made as early as the time of the civil war, when Gould and Baxter, in their statistics of the enlisted soldiers, proved that the immigrant representatives of European nations were always better developed than the corresponding people in Europe. It has not been possible, up to the present time, to learn whether this difference is due to better development here or to a process of selection, by which the weaker elements are eliminated before leaving their home country. It would be easy to ascertain the facts by an investigation of the arriving immigrants. That there is good reason to suppose that more favorable social surroundings in the United States have much to do with the better development of the immigrants is proved by the anthropometrical statistics collected by Bowditch in Boston and by Peckham in Milwaukee, who found that the children growing up in America are better developed than European children. Although much additional material has been collected on the old lines, the fundamental questions which are involved in this investigation have never received adequate attention. Statistics which I had occasion to collect recently seem to show that the development of children of immigrants is the better the longer their parents have been in the United States. I presume this merely suggests that the economic well-being of the immigrants increases, on the whole, with the length of their stay here, and that the corresponding better nutrition of the children results in better physical development. Whether, however, the whole change can be explained adequately in this manner is open to doubt. It is quite possible that the type may undergo certain changes due to environment.

In how far types must be considered as stable is a question in regard to which there is still considerable diversity of opinion. Investigators like Kollmann maintain the absolute stability of the types now existing; while, on the other hand, indications are not absent which suggest a changeability of types, at least in certain respects. It would seem that stature may be considerably influenced by long-continued more or less favorable environment. There are investigators who maintain that the more or less energetic use of the jaws may influence the form of the head, owing to the pressure brought about by the muscles, which tend to compress the skull laterally. On the other hand, we have very clear evidence that features, like the form of the head, the form of the face and stature, are inherited from generation to

generation with great persistence. As long as these questions are still so far from being settled, it seems necessary to take into consideration the possibility of a change of type in the immigrants, due to the new surroundings in which they have been placed. Some anthropologists in America have even gone so far as to claim that the geographical environment affects the European in such a way that he begins to resemble the Indian type. I have failed to find, so far, even a trace of evidence on which this opinion can be based.

The only indication that I can offer which might suggest an influence of environment is an observation which I made a number of years ago in Massachusetts, where I found that the variability of type was remarkably low, considering the mixed composition of the population—a variability which is less than the corresponding values obtained in Europe. But a sporadic observation of such a character is, of course, entirely insufficient to solve a problem of this magnitude. It would seem to my mind that one of the most important and fundamental investigations that have to be made in regard to the question of the biological assimilation of immigrants is a thorough discussion of the sameness or change of type of the second and third generations.

It has often been observed that the local types which have developed in America show a considerable amount of individualization. Some of this may very well be due to the influence of environment. It might be, for instance, that the tallness of the people of Kentucky is due to the limewater of that area. This would be in accord with the observations made by Rœse in Gotha, who found that the stature in that city had changed with the introduction of hard water. It will certainly be possible to carry through this inquiry among a people like the Italians or Swedes, where the anthropometrical conditions of the home country are fairly well known, while for many other nationalities parallel inquiries in Europe and in America would be necessary. Even if, by extended inquiries into the physical characteristics of the descendants of immigrants, the modifications of their type should become well known, the problem would still remain. In how far do these types increase in a pure state after their migration, in how far do they tend to become extinct, and what tendency they have to mix with the rest of the population. It seems best to defer a discussion of this question until after consideration of the influence of race intermixture.

Here we may consider again the physical effect of intermixture and the propagation of mixed types independently. I regret to say that the available information in regard to this point is, if anything, more meager than that relating to the modification of types after their migration into this country. The fundamental question that must be asked is, whether the mixture of two distinct types of man tends to produce an intermediate homogeneous type in which certain of the characteristics of the parents appear blended, or whether the resultant tends to exhibit reversion to the parental types. This reversion may again be twofold. We may either find a complete reversion to one of the component parental types, or we may find a mixture of traits, some resembling the one parent, some the other parent. Obviously this question is most intimately related to the whole study of Mendelian inheritance, which occupies such a prominent place in the work of modern biologists. So far, the results obtained from a study of human types are few in number. I believe the earliest observation in regard to this subject was made by Felix von Luschan, who found as early as 1884 that the inhabitants of the south coast of

Asia Minor, who are the descendants of intermarriages between a short-headed type of the central parts of Asia Minor and of the long-headed south coast type—a mixture which has continued for thousands of years—show clear evidence of alternating inheritance. In 1895 I was able to show (utilizing fairly extended observations) that the mixed blood resulting from unions of American Indians and whites shows, in regard to certain traits, a clear tendency to reversion to either parental type; while in other respects (for instance, in stature) new characteristics seem to develop. A recent inquiry into heredity among east European Jews shows that here also the children show a tendency to revert either to the father's or to the mother's type. This result is interesting, because it bears upon unions inside of a fairly uniform type of man. Other observations relate to the inheritance of abnormal traits, all of which seem to suggest, if not true Mendelism, at least the occurrence of alternating inheritance. However, the observations on mixtures of Indian and white have shown that while alternating inheritance may be found in regard to such traits as the form of the head and face, the development of the bulk of the body follows different laws. Notwithstanding these observations, the whole problem of the effects of race intermixture upon the various characteristic traits of human types is entirely unsolved.

It is not too much to say that the whole work in this field remains to be done. We do not know what weight to give to the small differences of types such as are found in Europe, and whether these differences are sufficiently great to be considered important as compared with the differences between individuals of the same geographical type but belonging to opposite ends of the local series. We must not forget that the people of Europe in each locality are very variable, and that we may find (for instance, in Scotland) considerable numbers of individuals who will differ from one another more than do the average individuals of, let me say, Scotland and southern Italy. The question of the effects of intermixture of types can, therefore, not be treated entirely separately from the question of intermarriages among people belonging to the same locality. And it is worth considering whether the remoteness of blood relationship in different parts of Europe, as compared to the closer blood relationship inside of a narrow territory, may not outweigh all the influences of the differences of geographical types. The whole question seems to be most complex, and worthy of the most detailed and thorough study; but I do not venture to predict the anatomical and physiological effects of intermixture without a most painstaking investigation, which has not been made up to this time.

Considering our lack of knowledge of the most elementary facts that determine the outcome of these processes, I feel that it behooves us to be most cautious in our reasoning, and particularly to refrain from all sensational formulations of the problem, that are liable to add to the prevalent lack of calmness in its consideration; the more so since the answer to these questions concerns the welfare of millions of people.

The problem is one in regard to which speculation is as easy as accurate studies are difficult. Basing our arguments on ill-fitting analogies with the animal and plant world, we may speculate on the effects of intermixture upon the development of new types—as though the mixture that is taking place in America were in any sense, except a sociological one, different from the mixtures that have taken place in Europe for thousands of years; looking for a general degradation, for re-

version to remote ancestral types, or towards the evolution of a new ideal type—as fancy or personal inclination may impel us. We may enlarge on the danger of the impending submergence of the northwest European type, or glory in the prospect of its dominance over all others. Would it not be a safer course to investigate the truth or fallacy of each theory rather than excite the public mind by indulgence in the fancies of our speculation. That these are an important adjunct in the attainment of truth, I do not deny; but they must not be promulgated before they have been subjected to a searching analysis, lest the credulous public mistake fancy for truth.

If I am not in a position to predict what the effect of mixture of distinct types may be, I feel confident that this important problem may be solved, if it is taken up with sufficient energy and on a sufficiently large scale. An investigation of the anthropological data of people of distinct types—taking into consideration the similarities and dissimilarities of parents and children, the rapidity and final result of the physical and mental development of children, their vitality, the fertility of marriages of different types and in different social strata—such an investigation is bound to give us information which will allow us to answer these important questions definitely and conclusively.

The final result of race mixture will necessarily depend upon the fertility of the present native population and of the newer immigrants. It has been pointed out repeatedly that the birth-rate of Americans has declined with great rapidity, and that in the second and third generations of immigrants the same decline makes itself felt. It will therefore be important to know what the relation of fertility of different types may be.

If the fertility of foreigners continues high without a corresponding higher death-rate of children, we may anticipate a gradual increase of the physical influence of the more fertile type. The immigration of the divergent types of southern and eastern Europe is, however, so recent, that this question can not be answered until at least twenty years more have elapsed.

No less important than the fertility of each immigrant type by itself is the question, in how far they tend to intermarry. The data presented in our census reports do not give a clear insight into this tendency among various nationalities. The difficulties of collecting significant statistics on the problem are very great. They appear particularly clear in the case of Italians. Married men from Italy come to the United States, earn some money, and go back to rejoin their families. They may come again, and, when conditions are propitious, they may finally send for their families to follow them. Thus we find among the Italian immigrants very large numbers who were married before they came here. It seems almost impossible to separate the contingent of couples married before their arrival here from those married after their arrival, and the chief point of interest to us lies in the intermarriages of children born in this country. It is natural that in large cities, where nationalities separate in various quarters, a great amount of cohesion should continue for some time; but it seems likely that intermarriages between descendants of foreign nationalities are much more common than the census figures would make it appear. Our experience with Americans whose grandparents immigrated into this country is, on the whole, that most social traces of their descent have disappeared, and that many do not even know to what nationalities their grandparents belonged. It might be expected—particularly in Western communities, where a rapid change of location

is common—that this would result in a rapid mixture of the descendants of various nationalities. This inquiry, which it is quite feasible to carry out in detail, seems indispensable for a clear understanding of the situation.

It is somewhat difficult to realize how rapidly intermixture of distinct types takes place, if the choice of mates is left entirely to accident. I have made this calculation; and I find that in a population in which two types intermingle, and in which both types occur with equal frequency, there will be in the fourth generation less than one person in ten thousand of pure descent. When the proportion of the two original types is as nine to one, there will be among the more numerous part of the population only eighteen in one thousand in the fourth generation that will be of pure blood. Taking these data as a basis, it is obvious that intermixture, as soon as the social barriers have been removed, must be exceedingly rapid; and I think it safe to assume that one hundred years from now, in the bulk of our population, very few pure descendants of the present immigrants will be found.

Unfortunately, however, we do not know the influence of racial cohesion. Obviously this is one of the fundamental points that ought to be known in order to gain a clear insight into the effect of recent immigration. The data collected by our census and by other agencies do not contain this information, which is one of the most urgent desiderata for an understanding of the composition of the American population. I may therefore express the hope that this question may be included in the census to be organized next year, or may be otherwise provided for by an inquiry to be undertaken under the auspices of the government. Without this information, the whole discussion of the effect of intermixture will remain speculative.

No material whatever is available to answer the question whether mixture of types is favorable for the physical development of the individual, or unfavorable. Statistics collected in the Argentine Republic tend to show that with a mixture of similar types, but from remote countries, considerable changes in the proportions of the sexes develop. Observations on half-breed Indians show that a type taller than either parental race develops in the mixed blood; that the fertility of the mixed blood is increased; and I can not find any evidence that would corroborate the view, so often expressed, that the hybrid of distinct types tends to degenerate.

I have refrained entirely from a discussion of the social problem, which is no less important than the one referring to the physical types of the descendants of immigrants; and I do not intend to include this question in our consideration, which is devoted to the anthropological problem only.

I have also devoted attention essentially to the biological problems presented by the immigration of European nations, but I must not conclude my remarks without referring at least to the serious problem presented by the negro population of our country. When compared with the contrast between the negro and the white, the differences of the European types seem insignificant; and the unity of the European race, as contrasted with the negro race, becomes at once apparent.

I do not intend to take up the whole question of racial inferiority, which can not be treated adequately in the brief time that I can devote to this subject. I must confine myself to a statement of my opinion, which I have repeatedly tried to substantiate. I do not believe that the negro is, in his physical and mental make-up, the same as the European. The anatomical differences are so great that corresponding mental differences are plausible. There may exist

differences in character and in the direction of specific aptitudes. There is, however, no proof whatever that these differences signify any appreciable degree of inferiority of the negro, notwithstanding the slightly inferior size, and perhaps lesser complexity of structure, of his brain; for these racial differences are much less than the range of variation found in either race considered by itself. This view is supported by the remarkable development of industry, political organization, and philosophic opinion, as well as by the frequent occurrence of men of great will-power and wisdom among the negroes in Africa.

I think we have reason to be ashamed to confess that the scientific study of these questions has never received the support either of our government or of any of our great scientific institutions; and it is hard to understand why we are so indifferent towards a question which is of paramount importance to the welfare of our nation. The anatomy of the American negro is not well known; and, notwithstanding the oft-repeated assertions regarding the hereditary inferiority of the mulatto, we know hardly anything on this subject. If his vitality is lower than that of the full-blooded negro, this may be as much due to social causes as to hereditary causes. Owing to the very large number of mulattoes in our country, it would not be a difficult matter to investigate the biological aspects of this question thoroughly; and the importance of the problem demands that this should be done. Looking into a distant future, it seems reasonably certain that with the increasing mobility of the negro, the number of full-bloods will rapidly decrease; and since there is no introduction of new negro blood, there can not be the slightest doubt that the ultimate effect of the contact between the two races must necessarily be a continued increase of the amount of white blood in the negro community. This process will go on most rapidly inside of the colored community, owing to intermarriages between mulattoes and full-blooded negroes. Whether or not the addition of white blood to the colored population is sufficiently large to counterbalance this leveling effect, which will make the mixed bloods with a slight strain of negro blood darker, is difficult to tell; but it is quite obvious, that, although our laws may retard the influx of white blood considerably, they can not hinder the gradual progress of intermixture. If the powerful caste system of India has not been able to prevent intermixture, our laws, which recognize a greater amount of individual liberty, will certainly not be able to do so; and that there is no racial sexual antipathy is made sufficiently clear by the size of our mulatto population. A candid consideration of the manner in which intermixture takes place shows very clearly that the probability of the infusion of white blood into the colored population is considerable. While the large body of the white population will always, at least for a very long time to come, be entirely remote from any possibility of intermixture with negroes, I think that we may predict with a fair degree of certainty a condition in which the contrast between colored people and whites will be less marked than it is at the present time. Notwithstanding all the obstacles that may be laid in the way of intermixture, the conditions are such that the persistence of the pure negro type is practically impossible. Not even an excessively high mortality and lack of fertility among the mixed type, as compared with the pure types, could prevent this result. Since it is impossible to change these conditions, they should be faced squarely, and we ought to demand a careful and critical investigation of the whole problem.

It appears from this consideration, that

the most important practical questions relating to the negro problem have reference to the mulattoes and other mixed bloods—to their physical types, their mental and moral qualities, and their vitality. When the bulky literature of this subject is carefully sifted, little remains that will endure serious criticism; and I do not believe that I claim too much when I say that the whole work on this subject remains to be done. The development of modern methods of research makes it certain that by careful inquiry, definite answers to our problems may be found. Is it not, then, our plain duty to inform ourselves that, so far as that can be done, deliberate consideration of observations may take the place of heated discussion of beliefs in matters that concern not only ourselves, but also the welfare of millions of negroes?

Facts that could help us to shape our policies in regard to our race problems are almost entirely wanting. It has been my endeavor to show that by proper investigations much can be done to clear up these problems, which are of vital importance for the future of our nation.

FRANZ BOAS

COLUMBIA UNIVERSITY

THE INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY

WE take from the London *Times* some facts in regard to the seventh International Congress of Applied Chemistry, which will be opened at the Albert Hall, London, on May 27.

Previous congresses have been held in Brussels in 1894, in Paris in 1896 and 1900, in Vienna in 1898, in Berlin in 1903 and in Rome in 1906; this is therefore the first occasion on which Great Britain has been visited. The work of the congress has grown steadily, and its importance is realized all over the world. There is ample evidence of the interest taken in Great Britain, where in addition to Royal patronage the congress has received the support of several of the heads of the government departments who have become honorary vice-presidents. Sir Henry Roscoe, F.R.S. and Sir William Ramsay, F.R.S., are honorary president and acting president, respectively.

For some considerable time an organizing committee has been making the arrangements for the congress and has had the support, as vice-presidents, of the presidents of the Royal Society, the Society of Chemical Industry, the Institute of Chemistry, the Institute of Brewing, the Society of Dyers and Colorists, the Pharmaceutical Society, and the Society of Public Analysts, Sir William Abney, F.R.S., Sir Hugh Bell, Professor P. F. Frankland, Dr. J. Lewkowitsch, Dr. L. Mond, F.R.S., Dr. E. K. Muspratt, Sir Boverton Redwood, Mr. W. F. Reid, Mr. A. Gordon Salamon and Professor W. A. Tilden, F.R.S. The committee is a large one and includes in addition to representatives of the organizations already named members of the Royal Societies of Edinburgh and Dublin, the Royal Society of Arts, the Iron and Steel Institute, the Institution of Mining Engineers, the Institution of Mining and Metallurgy, the International Association of Leather Chemists, the Royal Agricultural Society of England, the Lawes Agricultural Trust, the Royal Photographic Society, the Faraday Society and the London Chamber of Commerce (Chemical Trade Section), with Mr. William MacNab as honorary secretary. In connection with this committee local committees are formed in the principal centers of the British Isles and foreign countries and the colonies with a view to furthering the interests of the congress.

The work of the congress covers a wide field, as is shown by the large number of sections into which it is divided, as follows: (1) Analytical Chemistry (president, Dr. T. E. Thorpe, C.B., F.R.S.); (2) Inorganic Chemistry and Allied Industries (Dr. Ludwig Mond, F.R.S.); (3) Metallurgy and Mining. Explosives—(*a*) Metallurgy and Mining (Sir Hugh Bell), (*b*) Explosives (Sir Andrew Noble, F.R.S.); (4) Organic Chemistry and Allied Industries —(*a*) Organic Products (Professor W. H. Perkin, F.R.S.), (*b*) Coloring Substances and their Uses (Professor Meldola, F.R.S.); (5)

Industry and Chemistry of Sugar (Mr. Richard Garton); (6) Starch Industry—(*a*) Starch Industry (Dr. Horace T. Brown, F.R.S.), (*b*) Fermentation (Mr. John Gretton, M.P.); (7) Agricultural Chemistry (Lord Blyth); (8) Hygiene, Medical and Pharmaceutical Chemistry. Bromatology—(*a*) Hygiene and Medical Chemistry (Sir J. Crichton Browne, F.R.S.), (*b*) Pharmaceutical Chemistry (Mr. N. H. Martin), (*c*) Bromatology (Mr. Robert R. Tatlock, F.I.C.); (9) Photographic Chemistry (Sir William Abney, F.R.S.); (10) Electrical and Physical Chemistry (Sir John Brunner, M.P.); (11) Law, Political Economics and Legislation with reference to Chemical Industries (Lord Alverstone).

The sections will meet in the buildings of the University of London and the Imperial College of Science and Technology each day of the congress from 10 o'clock to 1:30 (except on the closing day), and on May 31 and June 1, from 4 to 6. On the evening of Wednesday, May 26, the day before the official opening, the mayor and the corporation will hold a reception of the delegates at the Guildhall. The prince of Wales will open the congress at the inaugural meeting to be held at the Royal Albert Hall on May 27, at 3 o'clock, and in the evening of that day a reception will be held by the foreign office. At 2:30 on Friday, May 28, lectures will be delivered to the whole congress by Professor Haller, of Paris, and Professor Paterno, of Rome, and at Crystal Palace in the evening a banquet will be held, at which it is expected a large number will be present. A garden party will be held at the Botanic Gardens on Saturday, May 29, by the ladies' committee, which has been formed, under the presidency of Lady Ramsay, for the purpose of entertaining the ladies accompanying the members; and later in the day a reception will be held by the London section of the Society of Chemical Industry at the University of London. On Monday, May 31, Professor Otto de Witt, of Berlin, will give a general lecture at 2:30, and at the same hour on the following day, June 1, Sir Boverton Redwood is announced to deliver a lecture to the whole congress. In the evening of Tuesday, June 1, a reception will be held at the Natural History Museum. The official closing of the congress will take place at a meeting held at 10 o'clock on June 2. In the afternoon members will, by permission of the King, visit Windsor Castle.

The offices of the honorary general secretary, Mr. William MacNab, are at the Imperial College of Science and Technology, South Kensington.

THE SUMMER MEETING OF THE AMERICAN CHEMICAL SOCIETY

The summer meeting of the American Chemical Society will, as already announced, be held in Detroit, Mich., on June 29 to July 2, inclusive. On the previous day a business meeting of the council will be held. The meetings of the sections and divisions will be held on Tuesday and Wednesday, June 29 and 30, and on Friday, July 2, in the Central High School, which has ample facilities.

On Tuesday evening a complimentary smoker will be given by the Society of Detroit Chemists to the members of the American Chemical Society.

On Wednesday afternoon the members will inspect the works of Parke, Davis & Co., to be followed by a lunch and a moonlight boat-ride on the Detroit River, complimentary to the visiting chemists from this firm.

On Thursday the members will take special cars to the University of Michigan at Ann Arbor, where they will be the guests of the University of Michigan for the day, returning to Detroit in the evening for the usual banquet. The program will be continued on Thursday at the University of Michigan and will consist mainly of special papers of wide general interest.

On Friday the sectional and divisional programs will be continued and excursions taken to manufacturing plants in Detroit.

The headquarters for the meeting will be at the Hotel Pontchartrain. Details in regard to this hotel and other hotels in Detroit may be obtained by addressing the secretary. It is suggested by the local committee that it is very necessary to make hotel reservations in

advance, as Detroit is liable to be crowded at this time.

Special arrangement is being made for the entertainment of ladies who accompany members.

CHARLES L. PARSONS,
Secretary

DURHAM, N. H.

FORMATION OF THE JOINT COMMITTEE ON THE UNIFICATION OF METHODS OF ANALYSIS OF FATS AND OILS

AT the last meeting of the Association of Official Agricultural Chemists, held in November, 1908, a committee of three was appointed to join with a similar committee, if such could be appointed, from the American Chemical Society and the American Society for Testing Materials, the object being to try to bring about uniformity in the methods of these three great chemical societies, and also that this joint committee should represent this country in the formation of an international commission upon this same subject.

The committee appointed by the Association of Official Agricultural Chemists consisted of Mr. L. M. Tolman, chairman, Mr. Percy H. Walker and Mr. A. Lowenstein. The committee from the American Chemical Society consisted of Mr. A. H. Gill, chairman, Mr. David Wesson and Mr. C. E. Waters. The committee appointed by the American Society for Testing Materials consisted of Mr. C. N. Forrest, chairman, Mr. Jerome Frank and Mr. G. W. Thompson. These three committees have united into the formation of a joint committee, Mr. Tolman being elected chairman, and Mr. Forrest, secretary.

The work of this joint committee is to bring about as far as possible a uniformity in methods of analysis and statement of results. The first meeting was held in New York at the Chemists' Club on May 25, for the consideration of plans of work, and of carrying them on.

THE PUGET SOUND MARINE STATION

A LABORATORY for the study of marine biology has been established by the State University, the State College and the three State Normal Schools of Washington in cooperation. This is located on the islands of the lower Puget Sound, a region unapproachable for its wealth of marine life. For the session 1909 the laboratory will be maintained at Friday Harbor on San Juan Island from June 21 until July 10, and at Olga on Orcas Island from July 12 until July 31. The following courses are announced: Exploratory Zoology, C. T. Brues, curator of the Milwaukee Public Museum; Invertebrate Zoology, H. S. Brode, professor of biology, Whitman College; Vertebrate Zoology, A. D. Howard, professor of zoology, University of Washington; Insects, A. L. Melander, professor of entomology, Washington State College; Molluscs, James L. Kellogg, professor of zoology, Williams College; Fishes, E. C. Starks, curator, Stanford University; Phylogeny of Plants, Charles E. Bessey, professor of botany, University of Nebraska; Cryptogamic Botany, Charles O. Chambers, professor of biology, Pacific University; Systematic Botany, R. K. Beattie, professor of botany, Washington State College; Ecology, T. C. Frye, professor of botany, University of Washington; Algæ, Mabel R. Simpson, professor of biology, University of Puget Sound.

The equipment of the station will include a steam dredging outfit, motor launch, scows, boats, etc. Microscopes and usual apparatus will be supplied. Tuition is free, but a laboratory privilege charge of ten dollars will be made for the six weeks courses. The Alaska-Yukon-Pacific Exposition at Seattle will afford an unusual opportunity of visiting the Pacific coast at low cost.

An invitation to make the station their headquarters is cordially extended to eastern biologists. Every opportunity will be given for the collection and study of the interesting species of Puget Sound. Correspondence may be addressed to Professor T. C. Frye, University, Seattle, or to Professor A. L. Melander, Pullman, Washington.

THE BIOLOGICAL STATION OF THE UNIVERSITY OF MICHIGAN

A STATION for instruction and research in biology will be maintained by the University

of Michigan, as a part of its regular summer session, during the eight weeks from June 28 to August 20 inclusive, 1909.

The station will be located near the Bogardus Engineering Camp of the university on a tract of about 1,700 acres of land owned by the university and stretching from Douglas Lake to Burt Lake in Cheboygan County, Michigan, seventeen miles south of the Straits of Mackinaw. This region, diversified by hills and valleys, was formerly covered by primeval forest, and vestiges of this still remain. It contains many lakes of clear water, unsurpassed in the state for size, depth and beauty of setting. The elevation of the camp, between two and three hundred feet above Lake Michigan, insures cool nights and makes the location favorable for hay fever sufferers. The topography of the region immediately about the Bogardus Camp is such as to afford a variety of floral and faunal conditions.

It is not the purpose of the station to duplicate the work offered at the university, but to provide facilities for field work of a sort that can not be so well carried on at the university or under the limitations imposed by a university schedule.

The courses of instruction will include: The natural history of vertebrate animals, freshwater special work and research in zoology, teachers' course in ecology, identification of trees and shrubs, botanical survey of the Bogardus Camp region, and research in ecology. Professor Reighard, head of the department of zoology, and Dr. George P. Burns, assistant professor of botany in the University of Michigan, will be in charge of these courses.

Not more than twenty students can be accommodated, and no registration will be accepted if received after June 10. Applications should be addressed to Professor E. H. Kraus, secretary of the Summer Session, Ann Arbor, Mich.

SCIENTIFIC NOTES AND NEWS

Mr. Oakes Ames has been appointed director of the Botanic Garden of Harvard University.

Dr. R. R. Gates, of the University of Chicago, has accepted a position in the Missouri Botanical Garden, where he will devote himself to continuing his cytological experiments and breeding experiments with *Oenothera.*

Dr. R. P. Verneau has been appointed to the professorship of anthropology in the Paris Museum of Natural History in succession to the late Professor Hamy.

Dr. Chalmers Mitchell, secretary of the London Zoological Society, will reside at the gardens when the society's library and offices are transferred there. Under him there will eventually be three curators, one each for mammals, birds and reptiles. Mr. R. I. Pocock, who is to retain his present post of garden-superintendent, will have charge of the mammals, and temporarily of the reptiles, while Mr. D. Seth-Smith is to take over the custody of the birds, combining with this duty the office of inspector of works.

Dr. Frederic Ward Putnam, Peabody professor of American archeology and ethnology in Harvard University, has resigned from active service. It will be remembered that Professor Putnam celebrated his seventieth birthday on April 16.

Professor Viktor von Lang has retired from the chair of experimental physics at Vienna.

A portrait of Dr. James Law, the first director of the Veterinary College of Cornell University, has been presented to the college as a gift of the New York state alumni. The presentation was made by Dr. G. S. Hopkins, and the portrait was accepted on behalf of the university by President Schurman. Addresses were delivered by ex-President White and Director Moore.

The faculty of the Massachusetts Institute of Technology at the last regular faculty meeting of the year adopted the following resolution by a unanimous rising vote:

Resolved, That the members of the faculty of the Massachusetts Institute of Technology desire to express to Dr. Arthur A. Noyes, upon his concluding his work as acting president, their [illegible]

sense of the service he has rendered by his admirable executive ability, his power of initiative, his untiring labor, his unfailing tact and his contagious enthusiasm. Under his skilful management a period which might easily have been one of discouragement and detriment has been marked by distinct and constant advance in the affairs of the school, and by the inception and progress of new and excellent measures in its administration. They also wish to declare their admiration for the unselfishness with which he has laid aside for the time being the original work in which he has gained such distinction, in order to devote his energy to the interests of the institute as a whole; and they thank him for the kindly and helpful spirit which has marked all his relations toward them, both official and personal.

The students have presented Dr. Noyes with a loving cup bearing an inscription as follows:

Presented to Dr. Arthur A. Noyes by the undergraduates of the Massachusetts Institute of Technology in gratitude for his faithful and efficient service, his warm-hearted sympathy and his unselfish devotion as acting president, 1907–1909.

WE are glad to learn that Dr. Edgar F. Smith, head of the department of chemistry and vice-provost of the University of Pennsylvania, has resumed academic duties after a long illness.

PROFESSOR JULIUS WIESNER has been elected a corresponding member of the Paris Academy of Sciences in the section of botany.

THE Royal Scottish Geographical Society has decided to award its Livingstone gold medal for the current year to Lieutenant Shackleton for his exploration in the Antarctic.

LIVERPOOL UNIVERSITY has conferred its doctorate of science on Mr. Francis Darwin and Professor J. L. Todd; its doctorate of engineering on the Hon. C. A. Parsons, and its doctorate of laws on Sir Donald Macalister and Mr. William Marconi.

DR. CHARLES W. ELIOT will give the commencement address at the University of Missouri on June 2, at the same time the doctorate of laws will be conferred on him.

McGILL UNIVERSITY, of Montreal, intends to confer the honorary degree of LL.D. on Dr. George A. Gibson, of Edinburgh, at the medical convocations on June 9. Dr. Gibson gave the inaugural address before the medical faculty of the university on September 22, 1908, his subject being "The Limits of Knowledge."

FOR the superintendence of the investigations at the National Physical Laboratory and for general advice on the scientific problems arising in connection with the work of the British Admiralty and War Office in aerial construction and navigation, a special committee has been appointed, which includes the following: President, the Right Hon. Lord Rayleigh, O.M., F.R.S.; chairman, Dr. H. T. Glazebrook, F.R.S. (director, National Physical Laboratory); Major-General Sir Charles Hadden, K.C.B. (representing the army), Captain R. H. S. Bacon, R.N., C.V.O., D.S.O. (representing the navy), Sir Alfred G. Greenhill, F.R.S., Dr. W. N. Shaw, F.R.S. (director, the Meteorological Office), Mr. Horace Darwin, F.R.S., Mr. H. R. A. Mallock, F.R.S., Professor J. E. Petavel, F.R.S., and Mr. F. W. Lanchester.

DR. L. O. HOWARD, chief of the bureau of entomology and permanent secretary of the American Association for the Advancement of Science, is in Europe to continue his study of parasites with which the ravages of the gypsy moth may be checked.

PROFESSOR N. E. GILBERT, of Dartmouth College, will spend a large part of the next year in study and investigation at the Cavendish Laboratory, Cambridge, England.

THE Senckenberg Natural History Society has awarded the Sömmerring prize to Dr. Paul Krämer, of Vienna, for his work on the inheritance of artificially produced reproductive adaptations.

PROFESSOR R. M. YERKES, of Harvard University, addressed the Scientific Association of the Johns Hopkins University on May 12 upon the "Scientific Method in the Study of Comparative Psychology," showing the importance of applying quantitative methods in the investigation of its phenomena.

Professor Taav. Laitinen, M.D., professor of hygiene and director of the Hygienic Institute in the University of Helsingfors, and chairman of the Finnish National League of Health, will deliver the third Norman Kerr Memorial lecture on July 20, in the lecture theater of the Victoria and Albert Museum, London. The subject will be "The Influence of Alcohol on Immunity."

The Harben lectures of the Royal Institute of Public Health, London, will be delivered this year by Professor R. Pfeiffer, director of the Hygienic Institute, Breslau, in the lecture room of the institute.

The directorship of the Pathological Institute of the New York State Commission in Lunacy is to be filled by civil service examination. Candidates must meet the following requirements: Five years' residence in a large public or private hospital for the insane; five years' experience as a successful instructor in neuropathology or psychiatry, or as chief of clinic; familiarity with German, French and English; familiarity with the insanity law of New York State and the administration of the department under the Commission in Lunacy; evidence of original research shown by contributions to clinical psychiatry, pathological anatomy of the nervous system, experimental psychology, etc. All submitted papers must be properly authenticated and reach the State Civil Service Commission on or before June 19. Candidates should give in their applications detailed information concerning their training and experience, especially in the lines mentioned. Subjects of examination and relative weights: psychiatry and psychopathology, 3; neurology and neuropathology, 3; experience and special training, 4. The salary of the position is $6,500.

The councilors of the American Geographical Society have accepted Mrs. Collis P. Huntington's gift of a $250,000 site for a new building at Broadway and 153d Street, New York City, overlooking the Hudson River. Mr. Archer M. Huntington, the president of the society, has given $50,000 toward the building fund, which will be increased by further subscriptions and the proceeds of the sale of the old building, which should be about $250,000.

The two-ton iron meteorite found in 1908 near Tonopah, Nevada, has recently been presented to the Field Museum of Natural History through the generosity of Messrs. Stanley Field, Richard T. Crane, Jr., Cyrus H. McCormick and George F. Porter.

The London *Times* states that Dr. Rendle, keeper of the botanical department of the British Museum (Natural History) at South Kensington, has just completed the rearrangement of the botanical gallery of that museum. The main series of exhibits represents the great plant groups with their families, including flowering plants, ferns, mosses, seaweeds and fungi. The groups are illustrated by pictures, specimens and models. The series of exhibits illustrating the British flora is rapidly approaching completion. The drawings of the larger British fungi are complete. The trustees, it may be mentioned, have just issued a handbook giving descriptions of all known British species illustrated by line drawings of the genera. There is a very interesting series of actual specimens of the larger fungi found near London, mostly on Wimbledon-common. These have been prepared in such a way as to show the structure. The British flowering plants, ferns and mosses are displayed in frames in such a way as to be easy of reference. This collection is intended not so much for the expert botanist as for the amateur who may wish to identify specimens without being under the necessity of a prolonged search in the great herbarium of the museum. Some volumes of illustrations of British plants are also available for consultation by the public. They are a recent acquisition, having been given by the artist, Miss E. N. Gwatkin. The lichens of Britain have been arranged in two cabinets, with descriptions and original drawings. The collection also contains cases illustrating points in the biology of plants, the fertilization of flowers, insect-eating flowers, parasitic plants, plants from dry countries, climbing plants and others. A case showing the abnormalities of leaves, flowers and fruits has also been arranged.

IT has been estimated that the amount of wood annually consumed in the United States at the present time is twenty-three billion cubic feet, while the growth of the forest is only seven billion feet. In other words, Americans all over the country are using more than three times as much wood as the forests are producing. The figures are based upon a large number of state and local reports collected by the government and upon actual measurements. The state forester of Connecticut, in a recent report, has given figures on growth and use for New Haven County, which give more details than are generally to be obtained, and illustrate how the forest is being reduced by over-cutting. In this county a very careful study was made on each township of the amount of forest, the rate of growth, and the amount of timber used. For the year 1907 the timber used was 120,000 cords, in the form of cordwood, lumber, ties, poles and piles. The annual growth on all types of forest land, including the trees standing on abandoned fields, for the year, reached a total of 70,000 cords. Thus the amount cut yearly exceeds the growth by 50,000 cords. The amount of standing timber considered as merchantable and available for cutting within the next few years was found to be 1,200,000 cords. Each year the annual growth increases the supply on hand by 70,000 cords, while the use decreases it by 120,000. The net reduction is therefore 50,000 cords a year. If the cut and the growth remain at the present figures, the supply of merchantable timber will be exhausted in about twenty years. At the end of that time there will be a large amount of forest standing in the county, but it will be in tracts under forty years of age, containing wood below the most profitable size for cutting. Cordwood could still be cut, but supplies of the most profitable products, like ties and lumber, would be practically exhausted.

UNIVERSITY AND EDUCATIONAL NEWS

MRS. MORRIS K. JESUP has given Yale University $100,000 to establish the Morris K. Jesup chair of agriculture in the Forestry School. The university has also received $50,000 for the School of Fine Arts and $50,000 for a memorial gateway.

DR. W. G. FROST, president of Berea College, announces that an industrial school for negroes will be established near Shelbyville, Ky., and the erection of buildings will be begun in a short time. A railroad station and a post office for the school will be established, called Lincoln, Ky. The endowment, largely given by Mr. Andrew Carnegie, amounts to $350,000.

THE University of Pennsylvania has asked the city of Philadelphia to transfer to it sixty-one acres of land adjoining the grounds of the institution in return for fifty free scholarships. The land wanted extends east to the Schuylkill River.

THE Goldsmith Company has given £50,000 to the Imperial College of Science and Technology, London, for a building extending the engineering department.

THE Bristol Town Council has decided to contribute in the proportion of one penny in the pound on the rate, or about £7,000 per annum, towards the support of the proposed university for Bristol and the west of England, for which more than £200,000 has been subscribed, mainly by members of the Wills family.

DR. EDWARD L. EARP has resigned his position as professor of sociology at Syracuse University to accept the chair of Christian sociology at Drew Theological Seminary, Madison, N. J.

MR. T. H. LABY has been appointed to the chair of physics in Victoria College, Wellington, New Zealand.

DR. M. CUTTA, associate professor in the Technological School at Munich, has been called to a chair of applied mathematics in the University of Jena.

DISCUSSION AND CORRESPONDENCE

SOME NEW DATA ON THE PROFESSOR'S FINANCIAL POSITION

A TEACHER on entering the profession generally tacitly assumes that after a certain

length of time of greater or lesser duration, and upon evidence of ability and progress along required lines, that promotion and salary will come of themselves.

That the expectation is small and that the realization is still smaller is a fact which soon impresses itself upon all in the teaching profession.

From personal observation, I believe that many are enticed into the career of teaching without due regard as to the discouraging pecuniary future, and I wish to suggest that all those desiring to teach be carefully made to see what the future has in store for them.

A teacher's salary is notably smaller than that which men of the same or even lesser ability obtain in other occupations; but I believe that teachers, as a class, have considered this but of small consequence and are not, as a class, envious of the far greater incomes of most of those with whom they meet in a social way.

They come under the class of salaried men who take no risks and hence do not share in the excess profits. A distinguished sociologist on my enquiry as to the position of the professor in the sociological order answered "You are all parasites." To a great measure this is correct, we are parasites, happily useful ones, but still parasites.

We are resigned to our fate; but lately some facts have come to my notice that have aroused my sense of justice and made me view with much less equanimity the low financial position of the teacher.

I have before me an authoritative manuscript by Colonel H. O. S. Heistand, of the Adjutant General's Department, U. S. Army, entitled "The United States Army as a Career."

The following extract is the portion which excites these feelings and also others which I believe most of those that read will have in common with me:

THE ARMY AS A CAREER

Let us see what the enlisted man is able to do in the way of accumulating a competence to provide for the declining years of his life.

If he has been an improvident spendthrift throughout his entire career and has not saved a penny, he will have as long as he lives his retired pay, which at the very least is equal in value to a paid-up insurance policy of from $10,000 to $20,000, non-forfeitable and guaranteed by the government. But a careful man would save half his cash pay when all necessaries are provided, and let us see what would be the result if he did so.

If he has remained a private soldier—the very lowest position in the army—during his entire twenty-five or thirty years' service, without ever having received any "extra-duty" pay or other special increase, and has saved and deposited with the government one half of his pay, and the amounts due him on discharge each time he reenlists, he finally quits the active list with the snug sum of more than $9,000, the income of which at four per cent. would yield over $30 per month; this added to his retired pay gives him a monthly income of nearly $65 per month for the rest of his life, and he is free to go wherever and occupy himself as he pleases.

Please notice that in this case and in the following cases the men own their capital and may withdraw it to go into business; and also that they are still comparatively young, that is, between 43 and 50 years of age, assuming that they enlisted between the ages of 18 and 25 years.

But for a soldier to remain a private so long is almost impossible; such a condition could result only from excessive indolence or a degree of stupidity that would seem to be a bar to original or subsequent enlistment. A fair supposition and one easy of realization would be that of a soldier who remains a private half of his first enlistment, then becomes a corporal; is made a sergeant upon reenlistment, and remains a sergeant the remainder of his career. Such a soldier, saving as above, would receive on final discharge nearly $15,000, this amount at four per cent. together with his retired pay would give him a monthly income of over $100 for the remainder of his life.

If instead of remaining a sergeant he reaches the grade of first sergeant and holds that position during the last nine years of his service, he will have saved about $16,000, which at four per cent. will yield an amount, which added to his retired pay, gives him over $120 per month. If the soldier is a private during his first enlistment, a sergeant in his second and third enlistments and then becomes a non-commissioned staff officer, say a commissary sergeant, his savings of one half

his pay, etc., as above, will amount to over $18,000 and with his retired pay will provide him an income of about $130 per month.

But even this by no means exhausts the possibilities of a career in the ranks of the army. For, if, say during the first three enlistments the soldier diligently applies himself to study in the army schools which are provided for him and advances sufficiently to become a master electrician, or if he have a musical turn and become a chief musician or sergeant in the band, his savings at the date of retirement will be just short of $24,000 and his total monthly income will be almost exactly $170.

None of the above cases are exceptions—all are within easy realization of the enlisted man who enters the army for a life business with a determination to succeed and prosper. Furthermore, at the date of retirement he will be in the prime of life and able to add to his capital and income for many years. Observation leads to the belief that very few laboring men or mechanics achieve a measure of success equal even to that possible for the soldier who remains a private during his entire career, and the easy possibility of the higher grades exceeds the average of success of the learned professions.

Men in business and professional life may contemplate a greater measure of success than this, but in doing so the great majority of them indulge only in pleasant dreams which are never realized. They suffer the dangers of fire, bank failures, industrial depressions and all the other enemies of success against which the professional soldier has the integrity and permanency of the government to protect him.

If the soldier does not desire to remain in the army for the full period of thirty years, he may quit at the expiration of any enlistment period, or he may purchase his discharge at any time after one year's service if he be not undergoing punishment or is not on duty at or under orders for duty at a foreign station; and if he chooses to save his money he will have between $300 and $400 at the end of a single enlistment. Surely he will not have wasted his time. After twenty years' service he may enter the Soldier's Home which is maintained by the federal government in the District of Columbia, and there spend his days in comfort.

Inquiry elicited the facts, which were to be expected, that a very similar outlook encouraged the *enlisted* man in the navy.

It seems to us that these extracts speak for themselves. The only requirements of admission of a man to all of these possibilities is simply that he be of sound body, of good moral character and be able to read and write English (?).

In comparison with what is required of the college professor the teaching profession has not a tenth of similar advantages to offer.

We can not retire without losing all claim to a pension, if we do so before a certain large number of years of service have passed.

The average teacher retires an old man after his energies have been used up in the furtherance of the public good that repays him so meagerly.

The pension, when it is obtained, is not nearly so large, in most cases, as that received by the soldier who, besides, *owns* a goodly part of the contributing capital.

All this is about the *enlisted* man. The officers have, of course, a more remunerative future before them.

The young cadet on graduation receives a minimum salary of $1,700 as second lieutenant. If he becomes first lieutenant or captain, which may occur very shortly, or at least the salaries of which grades he may receive shortly, his salary rises to $2,000 and $2,400 respectively. The salary of a major is $3,000. All salaries are subject to a ten per cent. increase every five years for twenty years if promotion should by any accident not take place long before that period is ended.

Besides these amounts the officers are allowed quarters and light for themselves and families and the privilege of obtaining all supplies at wholesale rates through the commissary department.

When in course of duty the officer must reside outside of the army post, the government allows him an extra amount called commutation of quarters, of respectively $24 per month for second lieutenants, $36 per month for first lieutenants, $48 to captains, the amounts increasing by $12 a month for each grade.

Adding this to the nominal salary and a percentage saving of one fifth or twenty per cent. in the cost of provisions, we have the totals for a newly graduated cadet or second

lieutenant, about $2,300, for a first lieutenant about $2,800, for a captain about $3,400. These are all low grades in the army.

What teacher receives anything approaching this on graduation from a college or even on receiving a doctor's degree after six more arduous years of hard study?

The salary on graduation of a Massachusetts Institute of Technology man as assistant is $500, with an increase to $600 the next year. It may in some institutions reach as high as $1,000, but that is exceptional.

A common soldier may reasonably look forward to retirement at the age of 45 or 50 years, with a life-long income of $2,040, and the opportunities to devote himself to a congenial pursuit.

One feels a certain amount of chagrin in meeting casually on a train an enlisted naval petty officer younger than himself who has $12,000 saved in the bank.

Why must the teaching profession be forever in such an unfortunate financial position in comparison with other callings? Have we not, as a class, enough common interest, enough moral courage to wage a campaign together for what is justly due us, for our labors? That is, a reasonable salary sufficient for our needs, sufficient for our family, sufficient to maintain the responsible and honorable position we now hold and which would in the event of a just increase become of much more influence in public life.

J. G. Coffin

FAIR PLAY AND TOLERATION IN SCIENCE

To the Editor of Science: I have read with surprise, if not indignation, Professor Blackwelder's discussion of Lowell's "Mars as the Abode of Life" in your issue of April 23, 1909; and feel that it is only just to enter a protest, in the interest of fair play and that degree of toleration which has always been characteristic of the better men of science. Professor Blackwelder speaks as if some great injury had been done to the public by the appearance of a popular book, written in a narrative style adapted to the lay demand. Of course this is wholly untrue, and mere idle vaporing. Lowell's popular works are all better than Proctor's and Flammarion's, and both of these latter writers have done valuable service in diffusing the results of scientific research among the multitude. It may sound very plausible to the scientific recluse to say that nothing but mathematical formulæ and tables are of value, but every well-informed man knows better. It is by the popularization of science that new interest is awakened in the public mind and increased opportunities provided for the extension of scientific research.

To take a specific example, it was the reading of a popular work by Huyghens, entitled "Comotheoros," which led Dr. Plume to establish the Plumian professorship of astronomy at Cambridge, which has been held by such distinguished mathematicians as Sir George Darwin, who has greatly extended our knowledge of mathematical astronomy, yet is not so narrow as to deny the value of popular science, but on the contrary has contributed to it by popular articles in magazines and a standard work on the tides.

If we compare the present state of astronomy in the United States with that in other countries, we shall be compelled to admit that American preeminence is due very largely to popular interest, and a general appreciation of results. Without popular diffusion of the results of scientific research, who among our business men and captains of industry could possibly have any interest in scientific work? In this day of specialization even scientific workers find it difficult to understand the labors of others, and the public is at vastly greater disadvantage. I make great use of logarithms, trigonometry and calculus, but I have yet to see the laymen who enthuse over columns of figures or complicated mathematical analysis.

When Proctor was living he was assailed by the self-appointed critics in much the same way as Lowell is now; but they always forget that there are others to be considered besides the mere priesthood of science. It sometimes seems to me that some of the latter are almost as intolerant as those divinely inspired persons who took it upon themselves to conduct

the inquisition during the middle ages. For one, I am not at all prepared to admit the justice of contemporary criticism, though in the long run a moderate and just opinion will prevail. This has been true in all ages and professions, and therefore is not confined to our own time or to any particular science.

Now as to some of the points cited by Professor Blackwelder as objectionable:

1. He finds fault with Lowell for adhering to Laplace's cosmogony; but let me point out that this same cosmogony very slightly modified, to take account of tidal friction, has been held by the most eminent mathematicians abroad.[1] If such views have been held by those who have spent many years on the subject, at such mathematical centers as Cambridge, England, surely Lowell may be excused for not accepting the inconsistent and purely destructive criticisms recently put forth at Chicago by Chamberlin and Moulton. It is only fair to say that no constructive results of consistent character had been reached on this subject till my own investigation was completed last year, of which an account is given in *Astronomische Nachrichten*, No. 4308 (February, 1909), but which appeared too late to be used in Lowell's book. As I have worked on this subject uninterruptedly for twenty-five years, I am prepared to speak with some degree of authority. If Professor Blackwelder will study my last paper carefully, and the work now in press, when it appears, he will find that most of the recent speculations on cosmogony are not worth the paper they are written on; and yet some of them have been published by the *Astrophysical Journal* and the Carnegie Institution, just as other erroneous and misleading papers have often been published by the Royal Society, the Paris Academy of Sciences and other learned societies of standing. Every experienced investigator recognizes the great amount of error that creeps into scientific literature even of the best type. How much more latitude, therefore, is to be expected in popular literature, which in the nature of the case must be entertaining rather than strictly exact and ultra-conservative!

2. Great fault is found with Lowell's claim that in general the terrestrial continents have been formed from the interior outwards, though he justly cites Dana, one of the greatest geologists of any age, in support of this view. Now I venture to say that Professor Blackwelder has not read carefully the four memoirs recently published in the *Proceedings of the American Philosophical Society* at Philadelphia, in which I have examined this question and the related topics with great care; otherwise he would see that, however deficient our knowledge may be as to details, in general his contentions are absolutely without foundation. In the opinion of many eminent men of science, including some of the foremost geologists and physicists, who have done me the honor to read these papers, I have proved that mountains are formed by the sea, and not at all by the shrinkage of the globe; and as the younger mountains are generally nearest the oceans it follows that the oceans are gradually drying up and the land increasing, as Lowell maintains. Therefore Lowell is right, and Blackwelder wrong; and that too in a subject which he represents as his own. Dana and Le Conte clearly understood that the mountains are related to and have in some way risen from the sea, but on the old contraction theory, now happily abandoned, they could form no correct conception of the cause of mountain formation. If Professor Blackwelder is prepared to contest my results, let him answer my argument on mountain formation in the case of the Aleutian Islands, where I have proved that they are a submarine mountain range now being pushed up by matter expelled from beneath the trench dug out in the sea bottom to the south of these islands; and that the whole movement is due to the secular leakage of the ocean and the resulting expulsion of lava beneath the crust, and nothing else. On this point other geologists have discreetly kept silent, but perhaps Professor Blackwelder "will rush in where angels fear to tread."

[1] Cf. paper by Mr. F. J. M. Stratton, on "Planetary Inversion," in the *Monthly Notices of the Royal Astronomical Society*, April, 1906.

3. Now in regard to life on Mars, it is sufficient to say that Professor Newcomb has justly remarked that the physical conditions on that planet are very similar to those prevailing in the Himalayas of Central Asia. But even the tableland of Tibet is inhabited, and maintains a respectable civilization. As Lowell has proved that there are water and clouds on Mars, and the polar snows melt and disappear with the advance of the summer seasons on that planet, why may there not be life there as well as here? Of course there is life on Mars; there is no doubt about it. But I am not prepared to say how far advanced the creatures on Mars may be; neither am I narrow enough to deny the possibility of their high development.

Perhaps it will interest Professor Blackwelder and others to know that I have just sent to the *Astronomische Nachrichten* and to the American Philosophical Society extracts from a letter of Euler, written in 1749, and published in the *Philosophical Transactions* of the Royal Society, before the cosmogonic theories of Kant (1755) and Laplace (1796) were put forward, in which the great Swiss mathematician, then residing at Berlin, even went so far as to say that the planets had gradually neared the sun from a great distance—thus implying that the earliest life originated on these bodies in the depths of space, before they came anything like so near the sun as they now are. Arrhenius holds a similar view to-day, and even thinks that life is carried by germs from one world to another.[3] In the work now in press, it is shown, on new grounds, that all the fixed stars are attended by systems of planets. Is Professor Blackwelder prepared to claim that all these billions of worlds are uninhabited? If not, why is he so unreasonable about the habitability of Mars? Lowell's view that there is life in the other worlds is sure to triumph, and we had as well come to it one time as another.

4. Professor Blackwelder is sure that Lowell is working for "a certain notoriety and a brief but undeserved credence for his pet theories." Let us, in common fairness, have no assignment of motives. These are seldom known in any man, either by himself or by others. If Professor Blackwelder is as candid as he wishes others to be, he will now come forward and say that there is much yet to be learned in every branch of science, including geology, and about contemporary scientific investigators as well, and that according to the best ethics, every tree must be judged by its fruit.

[3] Cf. "Worlds in the Making," *Harper's*, 1908.

Lowell has maintained for fifteen years a magnificent observatory, which has carried on valuable work on Mars, and the other planets and satellites; on double stars, both visual and spectroscopic; on the spectra of the outer planets; on comets and meteoric phenomena; on meteorology as related to the best sites for observatories; and on many other topics. He has given many young astronomers a chance to do good independent work, and the results obtained are highly valued throughout the world. What has Professor Blackwelder done in comparison? And is he the one to say that censure can not be too severe upon one who has deserved so well of American men of science as Professor Lowell has done? Let the still voice of conscience answer! Emerson says that alone all men are conscientious. If so, we shall have a little more toleration, and fair dealing, and less of this clique and faction business, by which a man who is not in the ring never can get justice or fair consideration. Of all the evils which afflict American science to-day the wide-spread tendency to partizanship and factionism and the resulting total disregard of the ultimate interests of truth, is undeniably the worst. As the truth is difficult to discover, and in the end will be found only among the errors of the wise, it is clear that every cause must be heard, and we must preserve a tolerant and open-minded attitude towards all contemporary work. Recent revolutions in all branches of science have been so great that no man knows, and no honest man will attempt to predict, what a day may bring forth.

T. J. J. See

U. S. Naval Observatory,
Mare Island, California,
April 30, 1909

SCIENTIFIC BOOKS

Annals of the Astronomical Observatory of Harvard College, Edward C. Pickering, Director. Vol. LVIII., Part III. Observations and Investigations made at the Blue Hill Meteorological Observatory, Massachusetts, U. S. A., in the Year 1905, Under the Direction of A. LAWRENCE ROTCH. With Summaries of Observations for the Lustrum and for the Twenty Years, a Discussion of them, Memoirs on the Meteorology of Total Solar Eclipses and on the Eclipse Shadow-Bands, and a Bibliography. 4to. Cambridge, 1908. Pp. 147–228. Pls. I.–II.

The same. Vol. LXVIII., Part I. Exploration of the Air with Ballons-sondes at St. Louis, and with Kites at Blue Hill. By H. HELM CLAYTON and S. P. FERGUSSON.

The work of the Blue Hill Observatory, whether it be the routine observations or the original investigations carried on by members of the staff, has always been of the highest grade of accuracy, interest and importance. The publications which have dealt with this work, both those in the regular series of the *Annals of the Harvard College Observatory,* and those which have appeared in various scientific journals, make up a list which includes some of the very best contributions to meteorology. Without Professor Rotch's generous and whole-souled support of the Blue Hill Observatory, and without the steady, careful and devoted work of himself and of his assistants, American meteorology would not occupy the important position in the world of science which it does occupy to-day. This statement can be made with perfect truth, and without in any way whatever disparaging the excellent work which has been, and is being, carried on by the United States Weather Bureau.

To review, adequately, the two volumes now before us is wholly out of the question in a journal in which meteorology necessarily has to occupy a subordinate position. We can only note the most important matters presented in these publications.

1. The first number of the *Annals* contains the 1905 observations, both surface and upper air, together with summaries of the observations at the ground during the preceding lustrum and the twenty years. As Professor Rotch points out in his introduction, there is probably nowhere else in the United States so homogeneous a series of observations, due to unchanged exposure of the instruments and methods of reading them. This, alone, gives these records considerable importance. The principal climatic features of the twenty-year period are, therefore, at this time appropriately indicated by Mr. A. L. Wells. Mr. H. H. Clayton gives an interesting summary of "The Meteorology of Total Solar Eclipses, including the Eclipse of 1905." Eclipse meteorology may almost be termed a meteorological curiosity, for total solar eclipses are infrequent, and their effects are not far-reaching, long-lived, or important. *Practically,* eclipse meteorology is therefore unimportant. *Theoretically,* however, there is much of interest in the subject. Mr. Clayton's paper gains much in general usefulness because of his bibliographic notes. His summary of results brings out the fall of temperature during total solar eclipses, with the notable fact that, in the free air and over the ocean, the time of minimum temperature occurs almost at the time of totality, while over the land surfaces the minimum temperature usually lags fifteen to twenty minutes after totality. A low vapor tension about the time of totality; a diminished wind velocity; an outflow of the "eclipse wind," and a maximum of pressure, all indicate a descent of air, are all phenomena connected with anticyclones. The author is firmly of the belief "that a cold-air cyclone is generated by the fall of temperature during an eclipse, and that the phenomena . . . are all results of this cyclone." The final paper in the first volume is one on "Eclipse Shadow-Bands," by Professor A. L. Rotch. In this the author gives the results which he has collected during many years, especially those obtained during the eclipse of August 30, 1905. "The inference from all the data collected is that the shadow-bands are produced by the diminishing crescent of light penetrating air strata differing in their thermal and hygrothermic conditions, and therefore in their refracting power."

2. More general scientific interest will probably attach to the second volume, which deals

with the results and methods of the pioneer work in *ballon sonde* meteorology, carried out by Professor Rotch in the United States with the financial cooperation of the Louisiana Purchase Exposition, and, later, of the Smithsonian Institution. Most men of science in this country probably already have a general idea of the importance of this investigation, and those who are able to keep up with meteorological literature know how widely this work has been discussed, and with what a warm welcome the results have been received abroad. If we mistake not, SCIENCE has contained several notices of this work. Mr. S. P. Fergusson contributes the first portion of the volume, on the "Apparatus and Methods," in which a brief account is given of the historical development of this kind of investigation. (It may be recalled that on March 21, 1893, MM. Hermite and Bésancon first employed a special instrument, recording time, pressure and temperature, which was sent up with a *ballon-sonde* in Europe.) "The Method of Reducing the Data" is discussed by Mr. H. H. Clayton. Then come a series of tables in which the records are given *in extenso*. "A Discussion of the Temperature and Wind," also by Mr. Clayton, follows. Particular interest attaches to the vertical temperature gradients, a subject which has been much discussed of late years, and which has important theoretical bearings. It appears that for all seasons the rate of decrease of temperature with increase of altitude above 2 km. increases up to about 8 km., then diminishes, and that there is an inversion in the gradient above 13–14 km., the well-known "isothermal stratum," whose existence was first established in Europe. Mr. Clayton contributes an interesting fact to the discussion concerning the cause of this isothermal layer. He suspects that a diminution in the northerly currents is characteristic of the region above 10 km., and that this may in part explain the phenomenon. The most frequent gradients in the lower air (0–1 km.) are the adiabatic gradients of dry air (0.9°–1.1° C.) and of saturated air (0.5°–0.6° C.). Inversions of temperature also show a maximum frequency in the lower stratum. Between 1,000 and 7,000 meters the prevailing gradients are the adiabatic gradients of saturated air. The adiabatic gradients for dry air diminish rapidly from the ground up to 2 km., and are rarely observed between 2 and 4 km. Above 4 km. they increase in frequency and reach a decided maximum between 8 and 9 km.; then decrease again in frequency to almost zero between 11 and 15 km. The upper parts of the two zones of maximum frequency of the adiabatic gradients of dry air are regions of maximum cloud frequency, the one zone being characterized by a prevalence of cumulus clouds, and the other by a prevalence of cirrus clouds. Cold waves, the author believes, are inclined strata of descending air, felt first at the earth's surface, and successively later at greater altitudes. The following statement is of special interest (pp. 81–82):

> At each successive rise of 2 km., the position of the area of cold in the anticyclone, and the position of the area of warmth in the cyclone, shifts northward in a semicircular course around the centers of the anticyclones and cyclones, until at 10 km. the area of cold is in the northern portion of the anticyclone, and the area of warmth is in the northeastern portion of the cyclone.

Our notice is already unduly long. We can but mention a final paper, by Mr. Clayton, on "The Distribution of the Meteorological Elements around Cyclones and Anticyclones up to 3 Kilometers at Blue Hill," an important contribution to a discussion to which our author has already devoted much time during recent years.

It is a pleasure to call the attention of the readers of SCIENCE to these valuable memoirs. Although the interest in meteorology is not as active or as widespread in this country as it should be, we feel sure that we are expressing the sentiments of a large number of our fellow-workers in science when we congratulate Professor Rotch, and his colleagues, most heartily, on their latest achievements in the field of meteorological research.

R. DEC. WARD

Bulletin of the American Museum of Natural History. Twenty-fourth Volume.

This large volume is only slightly less

formidable than its predecessor, and maintains the standard of excellence, the expression of *authority*, and the high typographical precision which has always distinguished this annual contribution to zoological literature. There are thirty-four separate articles—covering 647 pages, with thirty-three plates, one hundred and fifty-three text figures, which describe and illustrate two families, fifteen genera and subgenera, and two hundred and eleven species and subspecies "first described or renamed in this volume."

The initial impression made by an examination of the *Bulletin* is that of a voluminous contribution to systematology, in harmony with the first impulses that originated the work. Generalized articles are this year almost completely absent, and the rigorous, more technical requirements of science are only in a few places forgotten, as in some animated verbal excursions by Professor Wheeler, and the admirable historical review of the "North Atlantic Right Whale and its Near Allies," by Dr. Allen.

Mammalogy furnishes nine articles, ornithology two, entomology fourteen, vertebrate paleontology seven, invertebrate paleontology one, botany one. A serial notice of the articles as they succeed each other, with the most moderate epitomization of their contents, or, a reference to them by titles solely, will acquaint all interested with their nature and bearings.

In article I. Dr. J. A. Allen offers a "List of the Genera and Subgenera of North American Birds" according to article 30 of the International Code of Zoological Nomenclature. The subject is one identified with the author's name whose work in codification is historic. The work is confessedly intricate, and an inspection of the paper shows a master's hand. Dr. Allen remarks:

Our present fabric of nomenclatural rules has been of slow growth. Without going into detail, it may be noted that prior to 1842 there was no official code of nomenclature; each author was his own arbiter, not only as to the sources from which names might be taken and to whom they should be accredited, but in respect to the sense in which they should be employed.

There seems to be an argumentative intention in the paper, and it might not inconsiderately be classed as a polemic on the topic of "*Elimination* Versus the *First Species* Rule." A short but very interesting paper by Professor Whitfield on "Carboniferous Fossils and Semifossils from the Arctic" follows. The most important conclusions are the eminent expression of an American Coal Measure fauna in the north, and the determination of a new inarticulate brachiopod, *Arctitreta*. Professor T. D. A. Cockerell contributes two articles on the insect fossil fauna and fossil flora of Florissant, Colorado. A copy of the rare Pennant's "Indian Zoology" has recently been exhumed in the library of the American Museum, and furnishes a topic for Dr. Allen in article V. He remarks of it, that:

Like the copy in the British Museum, described by Newton, it lacks the original wrapper, and has no title page, and in all probability never had any, it being the first fasciculus of a work of which no more was published.

The plates are uncolored. Articles VI., VII., VIII., IX. and X. embrace characteristically elaborated descriptions of the ants of Porto Rico, the Virgin Islands (Culebra Vieques), of Jamaica, of Moorea, Society Islands, and of the Azores, the latter based on very insufficient and vestigial material.

Roy C. Andrews, a new author on the pages of the *Bulletin*, gives some new measurements of the North Atlantic right whale secured from the stranded Amagansett, L. I., specimen, which "exceeded in size the largest hitherto recorded." "A Four-horned Pelycosaurian from the Permian of Texas" is described in article XI. by Dr. Matthew, which is significantly called *Tetraceratops*, a new genus, whose "most noticeable feature is the presence of *two pairs* of prominent bony bosses or 'horns,' one rising from the premaxillaries, the other from the prefrontals."

This paper is succeeded by an important diagnosis of a new family of armored dinosaurs—the Ankylosauridæ—by Barnum Brown, the striking features of which are the "sculptured, plated skull; large flat or low-ridged body plates, some of which are united

as a shield; short spined vertebræ with parapophyses never rising above the centra; posterior ribs coossified to vertebræ."

In article XIII. Roy E. Andrews describes a new species of cetacean, *Mesoplodon bowdoini.* Article XIV. contains "Notes on Two Porpoises from the Pacific," by John Treadwell Nichols. "A Revision of the American Eocene Horses (*Hyracotheres*)," by Walter Granger is a very valuable study conducted along morphological lines with much care. In speaking of distribution the author says:

The horizon of their greatest abundance is the Wasatch, especially the Wasatch of the Big Horn Basin, where they predominate over all other forms, with the possible exception of *Systemidon*, a very closely related genus.

He remarks that "One of the progressive characters of the Eocene Horses is the gradual *molarization* of the second, third and fourth premolars in both the upper and lower jaws," and the concluding section of his paper deals with "Premolar Development." This article precedes a paper by President Osborn on "New Fossil Mammals from the Fayûm Oligocene of Egypt," wherein some anomalous characters indicative of new family relations are recorded. The paper is preliminary, and reports that the expedition into the Fayûm region of northern Egypt in the winter of 1906–7 obtained a collection of about 550 specimens, "including more or less complete remains of most of the fossil forms so far known to be characteristic of this region."

A comprehensive paper, dealing with the history, the relationships and nomenclature, the geographical distribution and external and osteological characters of the "North Atlantic Right Whale and its near Allies," by Dr. Allen, arrests both eye and attention in the middle of this big *Bulletin.* The article possesses a notable strength, and seems to be a compressed result of laborious and extended previous study. It is excellent reading, and reveals the solid emphasis of authority. It comprises about fifty pages, with six contributory plates.

The ornithologist W. De Witt Miller reviews the beautiful manakins (genus *Chiroxiphia*) in article XIX. The genus "is a small group difficult to define by structural characters alone, on account of the great variations in external form among the several species, but well characterized by the coloration of the adult males, all of which have a blue black and a red or yellow crest." Mr. Miller has prepared a most instructive map of the geographic range of the genus which is new, and original for the birds discussed.

Embracing articles XX. and XXI., and covering 139 pages Professor W. M. Wheeler elucidates the taxonomy and the economy of the Honey Ants, and describes the ants of Texas, New Mexico and Arizona. It is difficult at this point to specialize. The subject is engrossing and the author brings to the discussion an extraordinary wealth of experience, observation and reading. Comment is naturally impossible except by myrmecologists, but the most inexpert eye can not fail to linger over many paragraphs descriptive of the positively amazing economies of these insects, especially such differentiated abnormalities as the "npletes," individuals who become "living repositories for the surplus honey of the colony, which in time of need answers the purpose of the full honey-combs of the bee."

Article XXII. describes the Peary caribou, differing from its nearest allies *R. groenlandicus* and *R. arcticus* "in being much smaller, taking the skull as a basis of comparison, the females of *groenlandicus* and *arcticus* being as large as the *males* of *pearyi.*" The paper is by Dr. Allen.

Dr. Allen also furnishes article XXIII., which discusses the rare *Solenodon paradoxus* Brandt from San Domingo. These notes are based upon specimens collected by A. Wyatt Verrill, and the collector's remarks "based on actual observation of the animal in life," are probably the most trustworthy description of its habits known.

Mr. Verrill says:

In its habits the *Solenodon* resembles a hog, rooting in the earth and cultivated ground, tearing rotten logs and trees to pieces with its powerful front claws, and feeding on ants, grubs, insects, vegetables, reptiles and fruit, and at times

proving destructive to poultry. On several occasions it has been known to enter the houses in search of roaches and other vermin, and has been captured in rat-traps.

It is strictly nocturnal, and spends the day in caves, holes in the coral limestone rocks and in hollow trees and logs. It is a slow, stupid creature. It is unable to run rapidly, but shambles along with the zigzag, sidewise motions of a plantigrade. It is, doubtless, owing to this that it obtained the native name of "Orso" (bear).

Article XXIV. by S. A. Rohwer is on "A Fossil Larrid Wasp"; the same author contributes article XXV., a discussion of the fossil saw-flies (Tenthredinoidea) of the Florissant Shales. Article XXVI. comprises notes on the skull of *Lysorophus tricarinatus* Cope, by E. C. Case, of which the author remarks, that

Were it not for the extreme specialization of this limbless Gymniophiona-like form it would *occupy almost exactly the transitional position between the amphibians and reptiles.*

Article XXVII., by Dr. Matthew, particularly describes the osteology of *Blastomeryx*, and discusses the phylogeny of the American Cervidæ, in which the writer asserts that

Blastomeryx proves to be a very primitive deer, approximately ancestral to the American Cervidæ, and derivable in its turn from the Oligocene genus *Leptomeryx*, whose relationship to the Cervid phylum had not been suspected. We are thus enabled to trace the ancestry of the American Cervidæ back to the Oligocene, by successive stages known from the entire skeleton, and not merely from the inadequate evidence of teeth and jaws.

Article XXVIII. is by Filippo Silvestri, on the Myriopoda from Porto Rico and Culebra; article XXIX. consists of "Mammalogical Notes," by Dr. Allen; article XXX. is a further contribution by S. A. Rohwer on the saw-flies from Florissant, Colorado.

President Osborn contributes article XXXII. on "New or Little Known Titanotheres from the Eocene and Oligocene." Professor Wheeler discusses the "Ants of Casco Bay, Maine," in a very attractive paper, filled with descriptions of predatory expeditions, slave-making hunts and colonial devices and aspirations, which are picturesque enough in themselves, and are treated with very circumstantial seriousness. Professor Wheeler in this paper engages again in an extended debate on the origin of slavery (*dulosis*), and social parasitism in ants, wherein we are told that Wasmann has repeated Professor Wheeler's experiments on the formation of colonies, has corroborated them, and that "an outstanding difference in interpretation" only now remains between these distinguished naturalists.

The volume concludes with a paper by Dr. Allen, on "Mammals from Nicaragua."

L. P. Gratacap

SPECIAL ARTICLES

RADIUM IN SPIRAL NEBULÆ AND IN STAR CLUSTERS

In consequence of a prolonged study of the relation to celestial spectra of the spectrum of radium emanation as published by Sir William Ramsay and Professor J. Norman Collie,[1] I announced on January 19, 1905, the principle of "critical radioactivity" or the transformation of the chemical elements at critical pressures and temperatures in the stars. This explosive transformation of the elements at critical physical states, occurring in the heavenly bodies, I have named "radioaction," in order to distinguish it from ordinary radioactivity.

Radioaction, hypothesis *a*, was announced as a tested theory in the face of Rutherford's statement:

The transformation of matter occurring in the radio-elements is, on the other hand, spontaneous, and independent of temperature over the range examined.[2]

It was also in challenge of the natural inference to be drawn from the statement of Runge and Precht, made at the close of their account of the measurement of the lines of the radium spectrum:

Concerning all strong radium lines, it may be affirmed with certainty that, according to our measurements, they are not found among the measured solar lines of Rowland.[3]

Changes in pressure and temperature are, on all sides, said to produce no marked changes

[1] *Proc. Roy. Soc.*, 73, p. 470, May, 1904.

[2] "Radioactivity," first edition, p. 350.

[3] *Ann. der Phys.*, 317, 412, June, 1903.

in radioactivity, and, moreover, the precise measuremental matching of the lines of the radio-elements with celestial lines is universally held to be essential to their identification in the heavenly bodies. In direct violation of these views, radioaction, hypothesis a, was proposed and confirmed. A second principle, hypothesis β, which need not now be described, was also used from the first, and thence a set of principles of interpretation of celestial phenomena, deduced and verified, which, for brevity, I designate the theory of radioaction.

The theory was originally verified with difficulty by constantly summoning the calculus of probabilities to its aid, and kept from publication on account of obstacles encountered in presenting the vast mass of evidence.

Radioaction, or critical radioactivity, I have used the last five years, as a principle explanatory of many strange and hitherto inexplicable phenomena, of inorganic evolution. I have found radioaction to be an essential factor in cosmic evolution. By means of it I have been able to predict the necessary character of many phenomena peculiar to the morphology, photometry, spectroscopy and electro-optics of nebulæ, stars, sun and comets. Excepting two papers on this subject, read before the American Philosophical Society, one, "Universal Celestial Radioactivity," January 20, 1905, and the other, "Radioactivity in Solar Phenomena," April 14, 1905, both as yet unprinted, I have contented myself, of necessity, with the accumulation of proofs of the theory, until its presentation to the public in the form desired should be feasible.

Lately, however, the data for direct confirmation of this theory have come so freely to hand that I have decided to lay aside, in part, the ideal of aiming to present, as a unit, my theory of radioaction, with all its wide ramifications and interesting consequences.

Recently Mr. A. T. Cameron and Sir William Ramsay have remeasured the spectrum of radium emanation, and Professor E. Rutherford and Mr. T. Royds have also brought to bear all the refinements of physical accuracy upon the same problem; so that now there is available a body of information of the highest value concerning this spectrum.

Reflecting upon the use of this material, my theory suggested an investigation which resulted in a very simple and decisive confirmation of radioaction. This first and peculiar confirmation, due to the later determinations of the spectrum of radium emanation, I reserve for appropriate publication.

It was on April 26 of this year that I received Lick Observatory Bulletin, No. 149, recording the work of Dr. E. A. Fath on the "Spectra of Some Spiral Nebulæ and Globular Star Clusters." This bulletin permitted me, at once, to establish the fact that the absorption spectrum of radium emanation was present in this great nebula of Andromeda, and in other spiral nebulæ, and likewise present in the star cluster of Hercules (probably along with one line of radium), and in two other star clusters. It also came out clearly that the radium series of elements was not disclosed by the spectrum of the Spiral Nebula N. G. C. 1068. Finally, on referring to the observations of *bright* lines in the nebula of Andromeda by Sir William Huggins and Lady Huggins, I was gratified, but not surprised, to find that these lines were plainly identifiable as lines of radium emanation.

It has seemed proper to attempt here only a brief examination of the facts, since the present conditions prohibit a completely tabulated and detailed discussion. First, I must say that it is with no little satisfaction that I find myself reviewing this piece of superb work issued under the direction of Professor Campbell. For, in my study of radioaction, during these five trying years, I have again and again noted Professor Campbell's accurate and painstaking description of unusual celestial phenomena, his balanced review of the work of others (including the celebrated thrust concerning the Purkinje phenomenon), and his remarkable insight into the value of anomalous observations, and of mooted suggestions for their explanation.

The telescope used by Dr. Fath in the work was the celebrated Crossley reflector, with a specially designed spectrograph attached. The difficulties mastered were of the first order.

The total exposures ranged, in the case of the Andromeda nebula, up to $18^h\,11^m$, accumulated during three different nights, yielding fourteen lines; and in that of N. G. C. 7331 up to $22^h\,22^m$, accumulated during seven nights and yielding two lines. Of the accuracy of the wave-length determinations Dr. Fath says:

> When measuring known spectra the wave-lengths of the lines usually come within 5 or 6 Angström units of the correct value, although occasionally a larger deviation is found. Thus the third figure given may usually be considered correct.

In the identification of the lines, it is possible that Dr. Fath was unconsciously influenced by Scheiner's emphatic assertion:[4]

> It is thus proven that the Andromeda Nebula exhibits a spectrum of the class IIa, or further, that the greater part of the stars composing the nucleus of this nebula belong to the second spectral class.

The inference that "the spectrum is of the solar type" will, I think, be found to be too hasty. The absence from Dr. Fath's plates of any indication of the bright lines of Huggins was, indeed, quite misleading. Bright lines will, undoubtedly, be photographed, later, in the great nebulæ of Andromeda.

The following table records in the first and second columns the wave-lengths and intensities of the lines in the Andromeda nebula as measured by Dr. Fath, in the third and fourth columns the identifications with the spectrum of radium emanation suggested by myself, and in the last column, the identifications proposed by Dr. Fath.

TABLE I

No.	N. G. C. 244		Ra. E.		Identification by Dr. Fath.
	λ	In.	λ	In.	
(1)	3740	1/2	3739.9	7/1	Solar group, center λ 3735
(2)	3826	1/2	3816.0	2	Solar group, center λ 3830
(3)	3870	1/2	3867.6	4	Solar group, center λ 3872
(4)	3934	10	3933.3	3	Calcium K
(5)	3969	10	3971.9	9	He and Calcium H
(6)	4060	2	4055.7	1	Mean of Solar {λ 4046 Fe, λ 4064 Fe, λ 4072 Fe}
(7)	4156	2	4166.6	20/1	Solar group, center λ 4150
(8)	4203	1	4203.7	10	H δ
(9)	4230	1	4225.5	2	Ca, λ 4227
(10)	4303	5	4308.3	10	Solar G
(11)*	4385	2	4384.0	8	Fe, λ 4384
(12)	4456	1	4460.0	10	Solar group, center λ 4457
(13)	4675	1	4681.1	10	Solar group, center λ 4668
(14)	4855	8	H β		H β

The wave-lengths of the lines of the radium emanation are taken from the table of Rutherford and Royds.[5] The second number in the intensity column of radium emanation records, for line No. (1), the value by "photograph 3," and for line No. (7) the "visual" estimate. It should be borne in mind that for the nebular lines "the third figure given may usually be considered correct." Both schemes of identification are suggested by theory. Dr. Fath's is supported by the theory that the Andromeda nebula is a cluster of solar stars. No conclusive review has been given of such theory. From his own use of Bohlin's parallax of this nebula, he infers that "the 'star cluster' theory is not very satisfactory." He, however, necessarily recurs to solar lines and "groups of lines," selected, chiefly, on the basis of mere matching.

My own identification assumes the theory that all nebulæ whatsoever are electrically luminescent results of radioaction in the associated "stars." This theory has repeatedly been found to be confirmed in accounting for analogous phenomena. It explains why, now bright lines, now dark lines are observed in this nebula. It suggests the kind of chemical elements whose traits are here to be found. It accounts for the variability of this nebula in 1885, by asserting that the "star," variable through radioaction, holds the secret of cosmic evolution. Finally, it banishes the necessity for imagining a lawless collision of a pair of stars for generating spiral nebulæ.

The general agreement in wave-length of this single radio-element with all but one of the nebular lines must be given weight. There are three lines, Nos. (8), (9) and (10), which, both in the spectrum of the nebula and in that of the emanation, follow consecutively. Moreover, their intensities, all conditions considered, are quite consistent with the hypothesis of identity. There is no necessity for reminding spectroscopists that, on account of the wide variation of intensity with changes in excitation, fair agreements in such a case

[4] *Astrophys. Jour.*, 9, 150.

[5] *Phil. Mag.*, Ser. VI., Vol. 16, p. 317, Aug., 1908.

count toward the probability of identity, while disagreements do not count against it. I also call attention to the practical agreement in wave-length and in grade of intensity of lines Nos. (4) and (5). A detailed discussion of the probability of identification of each line seems unnecessary here. Admitting the uncertainty in the measurements of the nebular lines, considerable weight can fairly be given to general agreement. I have nothing to say to the spectroscopist who insists on the absolute matching of lines in wave-length as the final test of "identification" of all celestial spectra.

If radioactive outbursts determine both the bright lines and the dark lines, and account for the appearance and disappearance of the former, the celebrated bright lines of Huggins may supply a test of the theory. In the following table, the first column contains the estimated wave-lengths of *bright* lines observed in the nebula of Andromeda by Sir William Huggins and Lady Huggins,[8] the second and third, the corresponding radium emanation lines and their intensities observed by Ramsay, Collie and Cameron, and the fourth and fifth, those observed by Rutherford and Royds.

TABLE II

No.	N. G. C. 224 λ	Ra. E. λ	Ra. E. In.	Ra. E. λ	Ra. E. In.
(1)	580	580	(persistent)	583	1
(2)	543	543	faint	539.5	0
(3)	538	537	2	537	0
(4)	511 (a group of 4 or 5 lines)	508	2	512	2
				509	10
(5)	495 (a group)	498	2	496	1
		494	2	495	1
		492	3	492	1
(6)	476	477	2	477	1
(7)	455 (suspected)	458	3	458	1
		455	2	455	0
		452	1	451	1

For the sake of simplicity of statement, and so as to conform to the grade of accuracy of the estimates by the astronomical observers, only the first three figures of the wave-length measurements of the physicists are given. The general agreement is very satisfactory. Line (4) is "a group of 4 or 5 lines," and becomes so, first, because both lines concerned are relatively intense, and secondly, because, as astrophysicists well know, an intense line is at times likely to break up into a group. Line (5) is evidently "suspected" because of decreased sensitiveness of the eye for this region, and because of the low intensity of the three lines concerned.

A more detailed discussion would, I am sure, place this identification beyond any possibility of doubt, but also carry me farther into the subject than I had planned. It is worth while remembering, however, that admitting radioaction as receiving confirmation in other celestial bodies, it may here, with some weight, predict, as it does, the fact of bright lines, their variability, and their character as radioactive products. The two groups (4) and (5), examined on the basis of the strictest principles of electro-optics would alone prove identity, and their testimony is certainly not weakened by the other lines. The difficulties conquered by the famous chemist, and the masterful physicists in furnishing the measured lines of the rare radium emanation are certainly always most gratefully to be acknowledged; and the refined and conscientious work of Sir William Huggins and Lady Huggins in independently examining these evanescent bright lines of the nebula of Andromeda through the weary nights of many successive years, is, I hold, not only emphatically verified by this identification, but their faith in its high and lasting value adequately commended by the result.

The spectra of five other spiral nebulæ were likewise photographed by Dr. Fath at the Lick Observatory, and four of these, consisting each of but from one to three lines, disclosed, in each, identity with radium emanation in one to two lines. The spiral Nebula N. G. C. 1068 discloses, as stated, no known radio-element of the radium series, unless the bright λ 3733 and λ 3878 be helium lines. It is, however, practically certain that the celebrated main nebular lines characterizing the spectrum of this object, and of others like it, are due to radio-elements yet to be identified.

The spectra of star clusters next claim at-

[8] "An Atlas of Representative Stellar Spectra," p. 125.

tention. The spectrum of the Hercules cluster N. G. C. 6205, obtained by Dr. Fath is quite remarkable. He says:

It is composed of a number of parallel strips of different intensities, containing a few faint absorption lines. Each strip is probably the spectrum of a single star, or group of stars. No two strips contain the same set of lines. Four of the strips were strong enough to be measured.

In the following table the first column states the number of the strip, the second the wave-length, the third the intensity, the fourth the corresponding wave-length of radium emanation, the fifth its intensity.

TABLE III

Strip.	N. G. C. 6205		Ra. E.	
	λ	In.	λ	In.
(2)	3935	3	3933.3	3
(1)	3966	3	3971.9	9
(2)	3970	3		
(4)	4118	2	4114.9	7
(1)	4294	1	4308.4	2
(4)	4302	1		
(3)	4340	1	4340.8	50 Ra.
(4)	4463	1	4460.0	10
(2)	4790	1	4796.7	1

It will be noticed that to the single line of strip (3), I have assigned the radium line of high intensity, although an emanation line λ 4340.9, intensity 7, also exists. I think the evidence for the existence of radium emanation in this cluster is sufficient to make discussion unnecessary. It will be seen that for the different strips the lines vary. Difference of excitation, due to the difference of physical state of each star, completely accounts for the variation. In the globular clusters N. G. C. 7078 and 7089, the hydrogen lines are, as Dr. Fath indicates, probably evident from $H\beta$ to $H\theta$. Radium emanation must, however, also claim λ 4102.2, λ 3971.9 and λ 3933.3 in each of these star clusters.

It may not be amiss to venture a few suggestions:

1. Each photograph or observed spectrum of a nebula, star cluster, or bright line star, should be treated as a separate entity in publication; otherwise the successive changes in given lines are averaged out of existence.

2. If possible, the spectrum of the nebula of Andromeda should be repeatedly photographed.

3. It should be the aim to photograph as soon and as effectually as possible the spectra of the short-period variables in globular star clusters even if at first integrated results, both as to stars and as to periods, are obtained.

In conclusion, I must state that I am quite conscious of the incompleteness of this discussion. Indeed, it is the manifest complexity of the subject that has made me, hitherto, recoil from a preliminary application of the theory for publication. Radium has been known for at least ten years as a terrestrial element, its spectrum has been repeatedly determined and compared with the spectra of the heavenly bodies, and yet up to the present moment there has been published, so far as I know, no demonstrative evidence concerning its existence in the heavens. On the contrary, careful comparisons made by chemists, physicists and astronomers, have apparently shown that the spectra of radium and radium emanation, the element into which radium is at once transformed, are not identifiable with stellar spectra. It is, therefore, significant that the identifications here made were suggested by the theory of radioaction.

MONROE B. SNYDER
PHILADELPHIA OBSERVATORY,
May 3, 1909

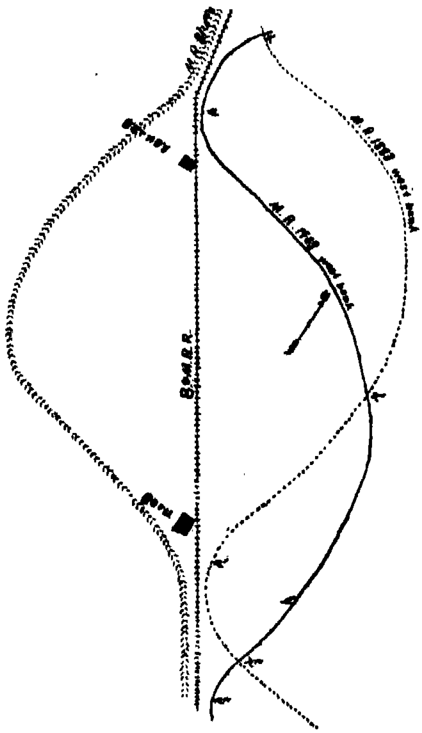
OBSERVATIONS ON THE SHIFTING OF THE CHANNEL OF THE MISSOURI RIVER SINCE 1883[1]

THE radical changes which annually take place in regard to the position of the Missouri River channel and the great loss of property occasioned by the same have presented a problem worthy our careful consideration. In addition to the scores of farms which are washed out annually the railroads suffer greatly by having their roadbeds destroyed. Hence, this becomes an economic problem of vast proportions.

In the following chart we have represented a portion of the river valley near the village of Peru, including ten or twelve miles of the river bed. The upper dotted line represents

[1] Read before the Nebraska Academy of Sciences.

the position of the western bank of the river in 1883 and the continuous line represents the position of the western bank in 1903. Locating the letters X, X' and X'' at the intersections of the old and new channels; then, all the territory between the old channel and the new and between X and X' has been washed from the Nebraska side, while the corresponding territory between X' and X'' has been



added to the Nebraska side. From the point a' to the point b is 5,000 feet, all of which has accumulated in twenty years, or an annual increase of 250 feet. The actual increase has varied, however, from 50 to 500 feet annually. At no time during the twenty years has the channel between X' and X'' encroached upon the Nebraska shore. On the other hand, the river has annually encroached upon the Nebraska shore between the points X and X' for the same period of time.

The river, at Peru, has a descent of about eleven inches per mile and the rate of flow varies greatly. During high waters, in the spring months when the principal washings take place, it is found that at the points a and a'' the water along the western shore has an elevation of 20 to 50 inches above that of the eastern shore, directly opposite. This piling up of the water along the western shore causes a part of the water to turn up stream, producing immense eddies at times a mile or more in circumference. The principal part of the water, however, is directed down the stream diagonally toward the opposite shore where the water is at a much lower level.

The most rapid erosion usually takes place in early spring at the time the ice breaks in the river; frequently, however, the June freshets play great havoc with the banks. The rate of erosion at the upper half of the curve is not the same as the deposition at the lower end of the same curve. For example, in twenty-four hours there may be from ten to twenty-five acres washed from the shore aX', while the accretion to the shore line $X'a''$ is very gradual. As the channel encroaches upon the upper portion of the curve it shifts farther from the lower portion. As the main channel recedes from the shore the space is usually transformed into eddies which supply the necessary conditions for depositing large quantities of detritus. In the shifting of the channel the symmetry of the curve is usually quite well preserved with reference to upper and lower halves.

Another factor enters our problem: the general direction of the river is southward and it is gradually flowing over larger and larger circles of the earth. Hence, the water piled up at a starts off in the direction of X' with the impetus given it from the piling up of the water. This rebounding force is counteracted by the influence of the rotary action of the earth by the time the water reaches X'; so, beyond the point X' the rotary action of the earth becomes the dominant factor and the water gradually falls behind until it again cuts the western bluffs at a''. Furthermore, the height to which the water is elevated at a determines, in a large measure, the distance aX' while the distance $X'a''$ determines the height to which the water is piled up at a''.

Hence, by locating the points a, a' and a'' one can determine, with almost mathematical precision, the land next in order to be removed and the location of the new deposit. Again, sooner or later points a and a' will coincide and lines aX' and $a'X''$ will coincide.

The dotted line yy' represents the manner of washing since this article was first prepared. The railroad and station at Barney have been washed out and a new station has been located farther to the southwest as indicated on the chart.

We have taken simply one section of the river as an illustration; but, after studying in detail a large number of these curves and after studying in a general way the entire river bed from Sioux City to the southern border of Nebraska we believe no exception to the chart can be found. In applying these principles to the washings of the eastern bank of the river all positions would be reversed.

The effort to hold the channel of the river under the bridges at Omaha and Nebraska City has greatly influenced the recession of the series of curves below each bridge.

We may, therefore, summarize the following points:

1. That the Missouri River channel is methodical in its shiftings.

2. The location of the new channel and the new deposit may be determined beforehand with mathematical precision.

3. There is a recession of the series of curves down stream.

4. The channel cuts the western bluffs at more or less regular intervals.

5. At no point does the river encroach upon the eastern bluffs.

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THE PROPER NAME OF THE AMERICAN EEL ANGUILLA ROSTRATA (LE SUEUR)

THROUGH an error in recording the date of publication the common American eel has been given a later-bestowed technical name and the author of a prior name and description has been denied the honor of first naming the American species.

In the *Journal of the Academy of Natural Sciences*, Philadelphia, No. 5, Vol. I., p. 81, C. A. Le Sueur described the common American eel under five specific names, viz.: *rostrata, Bostoniensis, serpentina, argentea* and *macrocephala*, all of which he erroneously placed under the genus *Muræna* of La Cepede.

Several months later C. S. Rafinesque, in *The American Monthly Magazine and Critical Review*, No. II., Vol. II., p. 120, described this eel under the name *Anguilla chrisypa* and *A. blephura*, and his note after the descriptions, "These two species of eels appear different from all the new species lately described by Mr. Lesueur, under the old name of *Muræna*, which belongs properly to a very different genus without pectoral fins," led me to look into the matter of the proper name for the American eel.

Rafinesque's name *chrisypa* has of late years been applied to this eel, authors citing 1821 as the date of publication of the journal in which Le Sueur's descriptions occur notwithstanding the fact that the numbers are plainly marked, No. 1, May, No. 2, June, No. 3, July, No. 4, August, and No. 5, September, 1817. From the dates and other marks on these numbers it was evident that they were promptly printed, but having been informed that the journal had not been printed and published, as dated, I addressed a note to Mr. Witmer Stone, of the Philadelphia Academy of Natural Sciences, and quote his courteous and satisfactory reply, written March 17, 1909.

My dear Mr. Bean: Such data as I have accumulated on dates of issue of our publications relate to our Proceedings only & I had little hope of solving the problem contained in your letter. Fortunately I asked Mr. Wm. J. Fox our Asst. Librarian if he knew of any clew and he suggested looking in a bound volume of manuscript letters from Thos. Say to Rev. J. F. Melsheimer, from which he had published extracts some years ago in Entomological News, as he thought there was some allusion to sending parts of the Journal to Melsheimer. Curiously enough the first mention of the matter that we found was as follows, in letter dated November 6, 1817, "yesterday I sent you the *Fifth* part of the Academy's Journal and tomorrow I will send you the *sixth*."

The fact that the sixth part was out or was daily expected would go far to prove that the fifth part had been out about a month. Any way we *know* that it was issued by Nov 6, 1817, and are pretty safe in saying that October was the month of issue, no doubt the first week.

I am glad to have been able to settle this matter for you, but the credit is due to Mr. Fox not to me. Sincerely yours,

Witmer Stone

The proper technical name for the common eel of eastern North America is *Anguilla rostrata* (Le Sueur), described from specimens taken in Lakes Cayuga and Geneva, New York.

B. A. Bean

U. S. National Museum,
Washington, D. C.,
March 20, 1909

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION L—EDUCATION

The Baltimore meeting of Section L showed that this new section is growing in strength and usefulness. The section's policy of devoting each session to a single topic with set papers by invited speakers was tried and proved a great success. The section plans to devote itself to a scientific study of educational problems, and has appointed a committee to study the distribution of students in elective courses in college and report at the next meeting. This committee consists of Professor E. L. Thorndike, chairman, and Messrs. J. G. Bowman, George E. Fellows, Abraham Flexner, C. H. Judd, Frederick Keppel and C. R. Mann.

Officers for the coming year were elected as follows:

Vice-president—Dean James E. Russell, Columbia University, New York.

Member of the Council—President Charles S. Howe, Case School of Applied Science, Cleveland.

Member of the General Committee—Professor Charles H. Judd, Yale University, New Haven.

Member of the Sectional Committee—Hon. Elmer E. Brown, United States Commissioner of Education, Washington.

Vice-president John Dewey presided at all the meetings. The address of the retiring vice-president, Hon. Elmer E. Brown, dealt with great insight with the subject "World Standards of Education." This paper will be printed in Science.

The first session of the section was devoted to a discussion of the United States Bureau of Education by Mr. W. Dawson Johnson, librarian of the bureau; Professor C. E. Elliott, of the State University of Wisconsin, and Mr. E. C. Moore, superintendent of schools, Los Angeles, Cal.

Mr. Johnson showed that the Bureau of Education is, on the one hand, the representative of the nation among the nations of the world; and, on the other hand, the representative of the common interests of the several states of the United States. As the representative of the United States in international intercourse its duty is, first, to study foreign educational experience with a view to selecting that which best fits American needs, and, second, to communicate to foreign countries official information regarding our own educational experience. This international intercourse may take the form of expositions, or congresses, or tours of investigation; it may require the direction of exchanges of professors and teachers between the United States and foreign countries, and of interchanges of students. With the development of international relations the work of the bureau as an office of international communication will become increasingly important, and as American conditions approximate those in European countries its service as a bureau of information regarding European educational experience will become more and more necessary. The duties of the bureau to the state departments are twofold: first, to relieve them of the duty of carrying on scientific investigations which may be carried on more economically or more efficiently by a central bureau; second, to carry on such other investigations as may facilitate and improve the administrative source of the state offices. The need of such work has been recognized in several states by the creation of special educational commissions. It has been recognized by the leading educational institutions and societies also. The growing recognition of the importance of such investigations and the advantages which a central bureau has for carrying them on must lead inevitably to the strengthening of the federal office. At present the bureau is being reorganized with a view to more adequate performance of its duties. The work of reorganization has begun in the library of the bureau. Little progress can, however, be made without larger appropriations by Congress, especially such appropriations as may enable the office to be of greater service to state school officers, educational commissions and legislative committees.

Professor Elliott pointed out that, notwithstanding the evident phenomenal advance which

all grades of education have made during recent years, there continues to exist such a spirit of general unrest and criticism of results as to preclude any feeling of satisfaction or security to serious students and workers in education. In the controversy between the educational progressives and the educational conservatives, society in general has assumed a defensible position and has accepted the program for progress as rapidly as the scientific soundness of that program was demonstrated. Our educational science in the past has been decidedly individualistic and the scientific problems of education have not been analyzed and delimited so as to permit the practical utilization of the collected results of accomplished investigation or the cooperative efforts of individual investigators. The real obstacle to progress has been the lack of coordinated and cooperative research. There is need to-day for scientific insight rather than emotional propagandism. Governmentally the center of gravity is shifting from the *state* to the *nation*. The traditional balance between state and federal activities has been overthrown and the signs of the times indicate the development of many new social functions, the full and adequate performance of which will depend upon the national government. Education, especially in its elementary and secondary stages, is the one subject of vital significance to human welfare, the scientific investigation of which the national government has not generously subsidized and encouraged. The expansion of United States Bureau of Education so as to enable it to serve as the central laboratory for American research in education, undertaking that now not undertaken, coordinating and organizing that now being attempted in a haphazard and incidental manner by individual institutions and societies, and causing it thereby to assume the leadership now so much needed for the real advance of American education seems to offer the greatest opportunity for the new federalism.

Mr. Moore's paper will be printed in full in SCIENCE.

At the second session of the section the topic "American College Education and Life" was treated by Professors Josiah Royce, of Harvard; Wm. North Rice, of Wesleyan; James H. Tufts, of Chicago, and Mr. Abraham Flexner, of the Carnegie Foundation for the Advancement of Teaching. These papers have been printed in full in SCIENCE for March 12 and 19 .

Two joint sessions were held: one with the American Psychological Association and the other with the American Federation of Teachers of the Mathematical and the Natural Sciences. At the first of these joint sessions the following program was given:

"Psychological Investigations that will help the Educator," by Professor E. A. Kirkpatrick.

"Studies in Number Consciousness," by Professor C. H. Judd.

"The Factors of General Ability," by Professor E. L. Thorndike.

"Homogeneous Content in the Measurement of Memory," by Professor C. E. Seashore.

"The General Effects of Special Practise in Memory," by Professor W. F. Dearborn.

"The Study and Treatment of Retardation," by Professor Lightner Witmer.

The report of this meeting has been published in the Proceedings of the American Psychological Association.

The other joint session with the science teachers was given up to a symposium on "The Problems of Science Teaching" by President Ira Remsen, Jonns Hopkins University, and Messrs. Wm. T. Campbell, Boston Latin School; George F. Stradling, Northeast Manual Training High School, Philadelphia; John M. Coulter, The University of Chicago, and Lyman C. Newell, Boston University. The report of this meeting has been published in SCIENCE for April 30, in connection with the report of the American Federation, and also in *School Science and Mathematics* for March and April, 1909.

C. R. MANN,
Secretary

THE ENTOMOLOGICAL SOCIETY OF AMERICA

THE fourth meeting of the Entomological Society of America was held in Baltimore, December 30 and 31, 1908, in affiliation with the American Association for the Advancement of Science.

The meeting was called to order by the president, Dr. W. M. Wheeler, in the Eastern High School, at 11 A.M., December 31. Dr. Fernald read the report of the committee on nomenclature. Moved and carried that this report be received and printed and discussed one year later, and that this should be the general policy in dealing with these reports. This report is appended. The managing editor made an informal report upon the condition of the *Annals*. The president announced the death during the year of Dr. W. H. Ashmead, an honorary fellow; Dr. James Fletcher,

a fellow, and of three members, C. Abbott Davis, Albert V. Taylor and Alexander Craw. The president announced that he had appointed committees to draw up suitable resolutions upon the death of Drs. Ashmead and Fletcher. These resolutions are appended. The secretary read a communication from W. C. Wood suggesting action looking toward abolishing the tariff on insects. Moved and carried, "That it is the sense of this society that the duty on insects is objectionable and should be abolished." The matter was referred to the executive committee with power. Adjournment until 1:00 P.M.

At that time the meeting was called to order by the first vice-president, Dr. J. B. Smith. The report of the nominating committee was read, and in accordance therewith, the secretary was instructed to cast a ballot for the following officers, which was done:

President—Dr. Henry Skinner.

First Vice-president—Professor Herbert Osborn.

Second Vice-president—Dr. A. D. Hopkins.

Secretary-Treasurer—J. Chester Bradley.

Additional Members of the Executive Committee—Professor J. H. Comstock, Dr. W. M. Wheeler, Mr. E. A. Schwarz, Dr. John B. Smith, Rev. Professor C. J. S. Bethune, Professor Lawrence Bruner.

Member of Committee on Nomenclature to Serve Three Years—Dr. E. P. Felt, to succeed himself.

There being no further business, papers were read as follows:

Notes on a Lecanio-diaspid: W. C. O'Kane.

A. N. Caudell spoke briefly on a method that he had adopted for preserving types. He uses Riker mounts for this purpose.

Contributions to our Knowledge of the Host Relations of Ticks: W. A. Hooker.

Discussion by Messrs. Skinner, Cooley, Viereck, Bruner and Miss Mitchell.

At 3 P.M. a joint session with Section F of the American Association for the Advancement of Science was held in the Eastern High School. Dr. J. B. Smith presided over the meeting. The following papers were read:

Investigations of Toxoptera graminum and its Parasites: Mr. F. M. Webster.

This paper was published in Science, February 12, 1909, p. 278.

Discussion by Professor Washburn and Mr. Hayhurst.

On the Muscular System of Spiders' Legs: A. Petrunkevitch.

A Note on the Habits of the Wall-bee, Chalicodoma muraria: J. N. Comstock.

This insect is very abundant at Dendera, Egypt, where it is covering the walls of the ancient temple, that have been unearthed, with its cement-like nests, rendering it impossible to read the inscriptions upon them.

Evolution and Adaptation in the Palpi of Male Spiders: J. A. Nelson.

To be published in full in the *Annals*. Discussion by Drs. Hopkins and Petrunkevitch.

Species, Varieties, Races, etc.: J. B. Smith.

Discussion was postponed until after the reading of the next paper.

What is a Species? H. Skinner.

Considerable discussion was evoked by these two papers, Messrs. Williston, Fernald, Felt, Viereck, Schwarz, Caudell and others participating.

Adjournment.

At 10 A.M. on December 31, the meeting was called to order by Dr. Wheeler, and the following papers read:

Death-feigning by Zaitha fluminea: H. P. Severin. Read by Professor Osborn.

Some Habits of Seed-infesting Chalcis Flies: C. R. Crosby.

The Development of the Scent-pockets of Anosia: W. A. Riley.

The pupal development of the scent-pocket or, as it is proposed to designate it, the murotheca, of the male Monarch butterfly was discussed. Its future position is indicated in the earliest pupa by the richness of the supply of tracheoles, indicative of the greater physiological activity in this region. Before pigmentation is apparent in the rest of the wing the murotheca stands out as a densely pigmented black disk overlapping vein Cu_2. Sections show that the androconia originate on the free surface of the upper wing membrane, which pushes out over the vein and later in pupal life folds on itself, giving rise to the pocket-like murotheca with its opening directed caudad. The structure of the androconal glands was briefly discussed.

The Tracheal Supply in the Central Nervous System of the Larva of Corydalis: William A. Hilton, Cornell University.

There are three pairs of tracheal branches going to the brain and two to the subesophageal ganglion. The first thoracic has one pair and a median tracheal branch. All the other ganglia have one pair except the last or eighth abdominal,

which has, in addition to the branches similar to the others of the other ganglia, large branches from the system of the seventh ganglion. The connectives between the ganglia with the exception of those between the subesophageal and first thoracic and those between the seventh and eighth, get all of their branches from the ganglia above and below them. In the case of the first exception, there are two additional branches from the outside. In the case of the second, all of the connective supply comes from the system of the seventh ganglion. There is in each ganglion a very complete superficial and deep network of large and small branches. The tracheoles in the center of the ganglia are very numerous and very intricately woven together, but in no place was anastomosis found.

Observations on the Taxonomy of the Cecidomyiidæ: E. P. FELT.

Recording and Mapping the Entomological Fauna of a State: FRANKLIN SHERMAN, Jr., State Department of Agriculture, Raleigh, N. C.

The 5 × 8 card is used as the unit, one side being rather closely ruled, while on the other side is printed an outline map of the state. Each insect is given a card—the divisions into orders, families and genera being indicated by appropriate guide-cards. All records as to place and date of capture are written in condensed form on the ruled side, while on the map a dot is placed for each locality. Gradually these records will define the different life-zones of the state and will indicate the approximate distribution of each species.

Rediscovery of the Bibionid Genus Eupeitenus: D. W. COQUILLETT.

In 1834 Macquart described *Penthetria atra* n. sp. from a male specimen in Serville's collection, captured at Philadelphia, Pa., since which time the species has not been taken again until April 26, 1908, on which date Mr. H. S. Harbeck collected a female specimen at Germantown, a suburb of Philadelphia. Walker, in 1838, referred two British American specimens to this species, but there is no certainty that his identification was correct. Macquart's figure is very faulty. In 1838 Macquart erected a new genus, *Eupeitenus*, for this species.

In the absence of the authors, or for other reasons, the following were read by title only:

Local Relations of Allied Species: S. A. FORBES.

On Some Terms used in Systematics: A. PETRUNKEVITCH.

A Colony of Mound-building Ants: E. A. ANDREWS.

The Conception of Unit-systems in Biology: W. E. RITTER.

Some Further Remarks on the Systematic Affinities of the Phoridæ: C. T. BRUES.

A Monographic Catalogue of the Mymarid Genus Camptoptera Foerster, with Description of One New North American Form: A. A. GIRAULT.

Studies on Aphididæ II.: J. J. DAVIS.

A Newportia in Utah: R. V. CHAMBERLIN.

The report from the excutive committee was read and, with all its provisions and recommendations, adopted.

The executive committee announced the election of the following fellows: Samuel W. Williston, Theodore Dru Allison Cockerell, Ephraim Porter Felt, Elmer Darwin Ball, Alexander Dyer MacGillivray.

Mr. Viereck moved to ask the committee on nomenclature to define what constitutes a species and variety, taking into consideration what the ornithologists have done, and that they bring the same up before the Commission on Nomenclature of the International Congress of Zoology one year before the next meeting of that congress.

Adjournment.

At 8 P.M., in the assembly room of McCoy Hall, the annual public address was given before the society by Dr. E. B. Poulton, Hope professor of zoology in the University of Oxford, on "Mimicry in the Butterflies of North America." The speaker was introduced by Vice-president Smith. A large and appreciative audience was in attendance. The address was illustrated by many beautiful colored slides.

J. CHESTER BRADLEY,
Secretary-Treasurer

RESOLUTIONS ON THE DEATH OF DR. WM. H. ASHMEAD

William Harris Ashmead, naturalist, honorary fellow of this society, died on October 17, 1908. We, his colleagues, would hereby give expression to our sorrow in the loss of a leader and a friend —one who gave himself unsparingly to the advancement of the science we cherish, who made himself by his zeal and industry one of the foremost students of the Hymenoptera in the world, and who furthered our progress by his numerous and valuable papers and by the prompt and generous aid he lent to every student who asked his expert knowledge and assistance. We gratefully acknowledge our debt to him, and we desire to place on record this testimonial of our esteem for him as a man, our pride in his successful career, our high regard for his scientific work, and our

sincere sense of irreparable loss at his passing away.

J. H. COMSTOCK,
J. G. NEEDHAM,
J. C. BRADLEY,
Committee

RESOLUTIONS ON THE DEATH OF DR. JAMES FLETCHER

WHEREAS, By the untimely removal of Dr. James Fletcher, the Entomological Society of America has lost—the first by death—one of its original fellows, and former vice-president, who presided at the Chicago meeting one year ago; and

WHEREAS, Dr. Fletcher, by reason of his nobility of character, kindness of heart and zeal, tempered by good judgment, was known and beloved among scientific men not only throughout the whole of the United States and the Dominion of Canada, but also abroad, as a careful, conscientious, scientific worker, a true Christian and a thorough gentleman; and

WHEREAS, His death, almost in the prime of life, is a serious loss to the applied science of entomology as well as of botany in America; therefore, be it

Resolved, That by and through these resolutions the members of this society express their grief over this loss, to two nations, of this truly fine, good man and colleague; and be it further

Resolved, That a page of the *Annals* of this society be set aside for the purpose of placing these resolutions on record and that the secretary be instructed to send a copy thereof to the bereaved family.

F. M. WEBSTER
F. H. CHITTENDEN
C. L. MARLATT

REPORT OF THE COMMITTEE ON NOMENCLATURE

Your committee desires to report that since its appointment, four matters have been presented for its consideration. Of these, one was the consideration of a particular case and was soon settled. The second is still under consideration; the third it has not, as yet, been able to take up, and the conclusions which the committee have reached upon the fourth case are herewith presented.

The nomenclature of gall insects was referred to the committee as the result of a paper by Dr. E. P. Felt presented at the last meeting. The committee is not unanimous on all points, but considers it desirable to present the following:

Report on the Nomenclature of Gall Insects.

In the literature relating to galls and gall insects, there are found several different kinds of description, accompanied by names.

1. Those relating to the galls only, with names intended to apply to the galls, not to their inhabitants.

2. Those relating to the galls only, but with specific names referred to particular insect genera, and intended to apply to the gall insects themselves, these being known at the time only from their work.

3. Those relating to the galls and the contained larvæ, with names proposed to be applied to the insects.

4. Those relating to the galls and the adult insects bred therefrom, and sometimes also to the larvæ, with names proposed for the insects in the usual manner.

5. Those relating to the adult insects, the galls being unknown, with names as usual.

I. It is agreed that in cases falling under 1, the names proposed do not enter zoological nomenclature. It is also obvious that in cases 4 and 5, the names are correctly proposed, and available for use if otherwise in accordance with the international rules.

II. It is the opinion of the committee that specific names based on larvæ (case 3) are available, and may be used.

III. With regard to the description of the gall, it is recognized that it forms a valuable part of the diagnosis of any gall insect, and that without it the recognition of the species may be difficult or practically impossible, especially when the description is not very detailed or precise. The committee is willing to accept a name based on the description of an adult or larva plus gall, even though the name would not be recognizable or of certain application were the account of the gall excluded from consideration.

IV. With regard to names applied as in case 2, intended to refer to the then unknown makers of known galls, it is the sense of the committee that, whenever possible, these names should be adopted.

V. The committee is not wholly in agreement as to whether it is obligatory to maintain names (if otherwise valid) proposed as in case 2; or whether, when they are maintained, the original author and date should be cited, or the author and date of the publication in which the insect itself is first described. The majority of the committee, however, is against the obligatory recognition of names accompanied by descriptions of galls only, and holds that when these are adopted, they properly enter nomenclature at the time of the description of the insect itself.

VI. The committee agrees, that whatever may be the ultimate ruling on the last point, there are many practical difficulties in the way of recognizing names proposed as in case 2, so that even were such names held to be available, many of them would have to be rejected as of uncertain application. It is perfectly clear that no rules will absolve an author from using his critical judgment in the several cases that come before him; and after the rules have declared a name available from their standpoint, it may be a long way to availability from the standpoint of practical identification.

The committee is greatly indebted to Dr. C. W. Stiles, the secretary of the International Commission on Zoological Nomenclature, for a full and luminous discussion of the matters in dispute.

H. T. FERNALD
T. D. A. COCKERELL
E. P. FELT

SOCIETIES AND ACADEMIES

THE MICHIGAN ACADEMY OF SCIENCE

THE 15th annual meeting of the academy was held at Ann Arbor, Mich., March 31 and April 1 and 2. The meeting was made the occasion of a Darwin Centenary Celebration, and the Research Club of the University of Michigan and the Michigan Schoolmasters' Club cooperated with the academy in furnishing special programs. The papers presented were as follows:

Program of the Darwin Celebration

Darwin Program of the Academy of Science.

Address of the president: "The Beginnings of Life from the View-point of a Bacteriologist," Dr. Charles E. Marshall.

"Theories of Animal Coloration, especially Warning Coloration," Professor Jacob Reighard.

"A Contribution to the Theory of Orthogenesis," Dr. Alexander Ruthven.

"American Paleontology and Neo-Lamarckism," Professor E. C. Case.

"The Mutation Theory from the Botanical View-point," Dr. Henri de Leng Hus.

The above papers were, for the most part, devoted to a discussion of the methods of evolution, from the standpoint of the original work of the speakers.

Public address under the auspices of the Research Club of the University of Michigan: "Darwinism and Paleontology," Professor W. B. Scott, Princeton University. In this lecture Professor Scott reviewed the evidence of evolution furnished by paleontology, and discussed the character of the evidence, using as illustrations the horse, camel, rhinoceros and other mammalian series.

Joint Session of the Science Teachers Section of the Academy and the Biological Section of the Schoolmasters' Club, S. D. Magers, chairman.

The Effect of the Darwin Doctrines:

"On Biology," Professor C. B. Davenport.

"On Psychology," Professor N. A. Harvey.

"On Education," President E. G. Lancaster.

"On Religion," Rev. Carl S. Patton.

As indicated by the titles, the papers presented at this meeting were concerned with the influence of the Darwinian theories upon the different fields of thought represented by the speakers.

Regular Program

Section of Agriculture, A. J. Patten, vice-president. (Held at the Michigan Agricultural College, April 14.)

"Some Reminiscences of the Attitude of Harvard Professors toward Darwin's Work," W. J. Beal.

"Darwin's Influence on Plant Breeding," H. J. Eustace.

"Darwin's Influence on Animal Breeding," A. C. Anderson.

"Further Experimental Work on the Interaction of Plant Roots," J. B. Dandeno.

"Advanced Methods in Milk Analysis," W. E. Robison.

"A Discussion of the Value of Raw Rock Phosphate for Fertilizing Purposes," A. J. Patten.

Section of Botany, Wm. E. Praeger, vice-president.

"Osmotic Theories, with Special Reference to van't Hoff's Law," J. B. Dandeno.

"Investigation on Bordeaux Mixture," J. B. Dandeno.

"The Rapid Extension of Weeds in Michigan," W. J. Beal.

"Origin of the Flora of Local Peat Bogs," Geo. P. Burns.

"The Effect of Longitudinal Compression upon the Production of Mechanical Tissue in Stems," L. H. Pennington.

"The Plasticity of Some of the Compositæ around Ann Arbor," S. Alexander.

"The Phytogeographical Relations of the Mount Ktaadn Flora," L. H. Harvey.

"Notes on Plant Pathology," J. B. Pollock.

"The Carbon Nutrition of a Fungus," Rose M. Taylor and J. B. Pollock.

"The Culture of Fern Prothallia," Elizabeth D. Wuist.

"Unreported Michigan Fungi for 1908," C. H. Kauffman.

"Methods of Sterilizing Seeds," R. de Zeeuw.

"Growth of Water Cultures in Various Solutions," N. W. Scherer.

"Variations in Leaves and Flowers," Henri de Leng Hus.

"Variations in the Dimensions of the Tracheids of *Picea excelsa*," S. M. Hamilton and W. H. Ramson.

Section of Geology and Geography, Wm. H. Hobbs, vice-president.

"The Comparison of the Loess Deposits of Europe and America," Frank Leverett.

"The Story of Niagara told in Photographs," Frank B. Taylor.

"An Ægerite-Oligoclase Aplite from the Lake Superior Region," Alfred C. Lane.

"The Differentiation toward the Most Fusible Mineral (Augite) in Non-hydrous Magmas," Alfred C. Lane.

"Occurrence of Sulphur in Sicily," W. F. Hunt.

"The Physiography of an Ancient Delta Region in Texas," E. C. Case.

"Some New Occurrences of Iodyrite," C. W. Cook.

"The Use of Crystallography in the Identification of Commercial Chemical Compounds," E. H. Kraus.

"The Iron Ranges of the Nipigon Region, Ontario," O. Bowles.

"The Iron Ores of Spring Valley, Wisconsin," R. C. Allen.

"New Apparatus for Instruction in Geology," Wm. H. Hobbs.

"The Raw Materials for Portland Cement in Alabama, together with Analyses," W. F. Cooper and Delos Fall.

"The Flint Water Supply," Alfred C. Lane and F. Harlan Bretz.

"Stadia of the Wisconsin Glaciation in North America," Frank Leverett.

Section of Sanitary Science, E. C. L. Miller, vice-president.

"Examination of a Commercial Ferment," W. E. Forsythe.

"The Standardization of Contact Insecticides," H. C. Hamilton.

"The History of the Sausage," Floyd W. Robison.

"The Organization of the Anti-tuberculosis Work," V. C. Vaughan, Sr.

"Situs Viscerum Transversus," Hugo A. Freund.

"Concerning So-called Agglutinoids," E. C. L. Miller.

"Staining of Sections by the Romanowsky Method," F. J. McJunkin.

"A Demonstration of the Effect of Alcohol on Gastric Digestion," S. D. Magers.

"Negri Bodies as a Diagnostic Factor in Rabies," Jas. G. Cumming.

"The Undetected Cases of Diphtheritic Infection of the Nose," Preston M. Hickey.

"Human Myiosis," A. W. Blain.

"The Wassermann Reaction," Jas. G. Cumming.

"Trypanosome Infection through Mucous Membranes," W. A. Perkins.

"Diagnosis Leishmania Infantum by Cultural Methods," F. G. Novy and P. A. Schule.

"Leishmaniasis," F. G. Novy.

Section of Zoology, Dana B. Casteel, vice-president.

"Notes on Michigan Reptiles and Amphibians," A. G. Ruthven.

"Notes on the Crayfish of Michigan," A. S. Pearse.

"The Early Development of Neurofibrillæ in *Rana pipiens and Ambystoma punctatum*," Hansford MacCurdy.

"Amitosis in the Nervous Tissues of Cryptobranchus," Q. O. Gilbert.

"On the Way in which Nematocysts Function," O. C. Glaser.

"Effects of Centrifugal Force upon the Embryonic Development of Some Chrysomelid Beetles," R. W. Hegner.

"The Germ Cell Determinants in Beetles," R. W. Hegner.

"Some Light Responses in the Jelly-fish, Gonionemus," Louis Murbach.

"Reaction of Amphibians to Light," A. S. Pearse.

"Method of Preserving Material for Vertebrate Dissection," J. J. Myers.

"Effects of Pressure upon the Embryonic Development of Some Chrysomelid Beetles," R. W. Hegner.

"The Distribution of the *Unionidæ* of Alabama," Bryant Walker.

"Notes on a Double Snail (*Campeloma* —)," Hansford MacCurdy.

"Notes on the Skeleton of *Chamæleon cristatus* Stutchb.," E. C. Case.

"Locality Memory in the Woodchuck," Jacob Reighard.

"Key to Michigan Gasteropods," H. B. Baker.

"Pearl Organs: A Secondary Sexual Character not Easily Explained through Use," N. H. Stewart.

ALEXANDER G. RUTHVEN

SCIENCE

FRIDAY, JUNE 4, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE NEW COLLEGE OF ENGINEERING OF NORTHWESTERN UNIVERSITY

DEDICATORY ADDRESS

THE beautiful new building which you to-day dedicate calls to my mind in contrast a plain old building at my own alma mater, in which my college work was done. The four walls of that building were as barren of architectural adornment as the cotton mills in the near-by village. And so the building had been known to many generations of students as "The Mill."

But in our minds our college building was a grist mill and not a spinning or weaving mill. Our college was not a place for spinning yarns, but for grinding away at our studies. Grinds, on each other or on our instructors, served to lighten and brighten our tasks. We considered ourselves choice wheat, which the old mill was to turn into the finest flour.

Realizing the associations which cluster in my mind around that old building, you will understand that I intend no disrespect if I liken your beautiful new building to a mill. A new mill, added to a large and prosperous manufacturing plant. A new mill to turn out a new product.

A new product, did I say? No, not a new product, but a staple article. There was a time, it is true, within the memory of men still young, when the engineering graduate was a novelty in the market—a novelty which sometimes found eager purchasers but which at other times literally went begging.

That era long ago passed away. Training men for the engineering profession in colleges is no longer an experiment. The engineering graduate is a staple product.

But even staple products are sometimes a

drug in the market. No man builds a mill to produce even such staples as flour or cotton cloth, without carefully examining market conditions. It is fitting, therefore, that we survey the market conditions for engineers. How stand the relations of demand and supply? What sort of engineers are most needed to-day? What grade of flour will you set your mill to grind?

Perhaps I can best picture to you market conditions in the engineering profession if I draw a parallel between the engineer and one of his favorite materials—Portland cement.

A quarter of a century ago, Portland cement was an expensive and little used article—just like the engineer of a somewhat earlier period. The valuable qualities and many uses of Portland cement were little appreciated when it was first introduced. The pioneer engineers suffered in like manner. To-day fifty huge mills are producing Portland cement where there was one a generation ago. So where there were four small struggling schools of engineering in the United States in 1850, there are to-day more than fifty times that number, and many of these schools number their students by hundreds and even by thousands.

Manifestly these huge mills for making Portland cement would not have been erected if the public had not found a use for their product. So also the engineering schools could not have multiplied in number and grown in size as they have done if the public had not found the engineering graduate a useful and valuable member of society. But I am bound to say to you that enterprise in the erection of Portland cement mills has at times outstripped demand, and as a result the cement market has been overstocked. The market for engineers follows quite closely the market for cement, and during the past two years there have been many idle cement mills and idle engineers.

With both the cement mills and the engineers it has been a case of competition, and survival—if not of the fittest, then of those best able to survive. Undoubtedly the increase in cement mills and in engineering schools has had the effect in each case of lowering the price of the product. But it is also true that this low price combined with excellent quality has enormously increased the demand, both the demand for cement and the demand for engineers.

Is the engineering profession overcrowded? Are its members underpaid? If you submit these questions to a jury of engineers, you will, I am sure, receive an affirmative verdict. But I suspect you would have the same sort of answer if you inquired of lawyers concerning the legal profession or of physicians as to the practise of medicine.

It is a fact, nevertheless, that certain changes in our educational system during the past half century have operated to swell the ranks of the engineering profession above that of other professions, and by the competition thus set up have reduced the compensation of engineers.

Half a century ago college education in the United States meant one thing only—the old-time standard course of studies in the classical languages and mathematics, with a smattering of elementary science and theology. With the rapid progress of science and the industrial arts there came about a powerful reaction against this ancient scholastic drill that had so long passed under the name of a liberal education. The demand arose that the college should teach something practical, something that would make the student better fit for his life-work. The answer to this demand on the part of the colleges was the introduction of a great variety of schools and special courses of study. Of all these schools, the

most popular and the most successful unquestionably have been the schools of engineering.

You will hear men blaming the engineering schools for overcrowding the profession. I do not think we can accept that criticism offhand. I grant you it is true that many more men have been graduated from our engineering schools in the past twenty years than can find employment in engineering work; but would it be well for the profession or for the country to have it otherwise? Must we not frankly recognize that of the men who graduate from our engineering schools every year, a very considerable percentage are not fitted by natural ability to become successful engineers?

I have great sympathy for the many individual cases of hardship that result from the overcrowding of the profession. I freely subscribe to the statement that the engineering profession as a whole is not paid in proportion to the responsibility it carries and the useful service that it renders to the community; and yet I can not believe it for the benefit of engineers or of the public to have the paths into the engineering profession made too easy or the rewards for the lower grades of engineering work too great. The older men in the profession can recall times when there were not enough engineers to meet the demand, when any man who knew how to handle a transit could command a good salary as an engineer. Some of the recruits brought in at such times have been an injury to the profession and to the public. An injury to the profession because the work of incompetent men in any profession injures its reputation and limits its chances for profitable employment. An injury to the public because the public has to stand the loss and the disaster that result from engineering incompetence.

It is not, then, a conclusive argument against increase in engineering schools that the profession is overcrowded. I yield to no man in honoring our profession. The best efforts of my life have been devoted to its advancement; but when the question is squarely put whether there are too many engineers, I am obliged to answer, there are none too many good engineers even though there be a surplus of poor ones. If engineers are underpaid, as I believe they are, it is because the public which employs engineers does not yet appreciate how valuable high-class engineering work is. Somebody has defined the engineer as a man who can do with one dollar what any fool can do with two. When all members of the profession appreciate and act on that definition, the public can well afford to pay princely salaries to its engineers. How many millions of dollars do you suppose might be saved annually in the United States if high-class engineering were substituted for mediocre engineering? Let me give you an example in just one single industry: steam power plants for generating electric current. One of the most prominent engineering firms in this country recently authorized the following statement: If good engineering were used in the design and operation of electric stations in the United States, a saving might easily be made of one fourth cent per horsepower hour, and that would have amounted last year to no less than $37,000,000.

I deprecate that competition in the engineering profession which lowers the pay of engineers. Competition in engineering ought not to be in rate of pay but in quality of service. A few days ago I received a letter from an official board asking what would be a proper salary to pay an engineer for taking charge of a piece of hydraulic construction involving an expenditure of a million dollars. I replied

that the salary they should pay ought to depend on the sort of man they secured. If they engaged a man of exceptional ability he would probably save them so much in the cost of the work that they could well afford to pay him twice or thrice what they would pay an ordinary engineer.

I am not here to indict my own profession. Far from it. But every member of it who has reached mature years, held large responsibilities and come in contact with engineers of all sorts in actual work, will confess that a very large amount of work is done poorly that ought to be done well. That many, many millions of dollars are wasted that might be saved by better design, better supervision, better execution. Engineers, let us confess, are not exempt from the frailties of humanity. Some of us are lazy, and will take the easy course and let things run on in the rut of routine rather than make the effort to prepare new designs to meet changed conditions. Some of us are arrant cowards, and rather than run any risks we will spend money like water—so long as it is not our own money. I have seen engineers of this type take credit to themselves for their conservatism, and prate in official reports about the high-class construction they had secured, when the fact was that they had spent thousands where hundreds would have satisfied every requirement.

I am perfectly well aware that there are men who defend that type of engineering. They claim that an engineer's business is only to look after accuracy, strength, permanence and safety in construction; to use only the best materials and accept nothing but the highest class of work. It is engineers of this type who are responsible for the idea, still too commonly held, that to put an engineer in charge of work means a great increase in its cost. If we had less such engineering, there would be a greater demand for engineers.

I am able to give you a personal illustration of the difference between the two types of engineering. Within forty-eight hours I have talked with men in Washington who know of the work your director has done there in a great government department of engineering work. He had the good sense to see that this work was only a means to an end, and that accuracy and hair-splitting refinement were only valuable where they were effective in the final result. He solved the problem, "What is worth while," and his solution has saved to the government tens of thousands and probably hundreds of thousands of dollars.

I want to see more engineers who are able to wisely solve this problem, "What is worth while," in a hundred lines of engineering work.

How many hundreds of millions of dollars do you suppose are expended annually in the United States in the promotion of foolish and absurd inventions or enterprises wrongly planned? It has long been a theory of mine that people ought to be saved from losing their money in such schemes by seeking the advice of engineers. But I have found that before my theory can be put into practise, we must have engineers who are wise enough and broad enough to give reliable advice on such matters. *And the public must learn to discriminate between the engineers who know and those who only think they know.*

I think it well to set forth these facts here for the encouragement of those who may be looking forward to the profession and who may have the feeling that engineering work has already reached such a stage of perfection that there is no room in it for further advancement or greater achievements. There *is* room and need to-day for better engineers and for a higher grade of engineering work.

And so your mill, although it is to grind out a staple product, is not designed to

undersell the market. You are not aiming merely to increase the output of engineering graduates. Your president has clearly emphasized in his address that it is not cheap engineers but better engineering that the public needs.

Magnificent work has been done for the engineering profession by our colleges. I believe our American system of training men for the engineering profession is far in advance of that in vogue in any other country. We must recognize, however, that the rapid changes in science and industry and engineering make changes necessary in our engineering schools. Imagine a boy to-day taking the course of study that was required at the Rensselaer Polytechnic Institute sixty years ago, and then going out to do engineering work. A high-school graduate of 1909 would be in many ways better equipped.

Go back only a quarter of a century and you will find that the engineering courses then in vogue would not suit present-day requirements. It is no argument for those courses that men who graduated from them have achieved eminence in the profession. Many men who were denied all educational advantages have become great by sheer ability.

So we face the question, What education shall the engineering college give to its students to-day that shall best fit them to win success in their profession?

I have called your institution a mill which is to turn raw material into a finished product. Well, it is raw, sure enough, but let us remember that the material is alive—and let us hope very much alive. I believe, after all, your college is not a mill, but—begging the pardon of the freshman class—a greenhouse.

Engineering education, like any other education worthy of the name, is a process of growth. To achieve success in your greenhouse culture you must have the right sort of plants to start with. Unless a boy has natural abilities of the right sort you can not make him into a good engineer.

On the other hand, boys with good natural abilities who can not afford a college training are going out into the working world all the time, beginning at the bottom rung of the ladder in some line of engineering industry, educating themselves in the school of daily experience, aiding that development by study in night schools and correspondence schools and by wide reading and observation.

I want to leave a wide door open into the engineering profession for the men who obtain their education in such a way. I want to deprecate any petty prejudice on the part of college-trained engineers against the engineers who have won success despite their lack of systematic college training. Such prejudice is as unworthy as that with which the so-called "practical" man met the engineering graduates of a quarter century ago.

The engineering colleges to-day must recognize the aids that are now available to the boys outside of the college, in the shape of the correspondence schools, for example. The question is, How shall the boy who spends four years or five years in the college achieve such growth that he can excel in competition the boy who has meanwhile been learning engineering by doing practical work.

For the past twenty years, the engineering colleges of the United States have been trying to answer this question by specializing their instruction in engineering, by multiplying the number of their courses, by trying to make men expert in one particular limited branch of engineering work. Now I am far from denying that there is a large demand and a certain field of usefulness for such special courses; but I believe the consensus of opinion among those best able to judge is that there has been too

much specialization in our engineering instruction. We have to-day in the engineering profession many specialists, but too few men with broad knowledge, broad abilities and a broad outlook.

One common defect in your self-taught engineer is that, however proficient he may be in the one field where he has had experience, he knows little outside that field. It is the lot of most engineers to change their occupation many times in the course of a lifetime. One branch of engineering work falls off and they are obliged to turn to another. It is the advantage of the man with the broad college training that he can do this with facility. The specialist, however, when work in his specialty fails, finds his occupation gone.

Perhaps the error which is most to blame for the specialization in our college courses is the error that the college education in engineering produces an engineer. The engineering graduate when he leaves the college halls is not yet an engineer, and would not be one even if you doubled the length of your course. There are indeed exceptions. An occasional young man of great ability and with a practical bent of mind will get enough out of his college course, supplemented by wide reading and vacation work, to be fit for considerable responsibility at graduation. But such exceptions only prove the rule. The college course in engineering is only laying a foundation on which the finished superstructure is to be erected through accumulated experience in actual work.

Now it may seem to some of you students a little disappointing to spend four or five valuable years and then only succeed in laying the foundation to become an engineer. But I want to assure you that it is in this very matter of foundation that the college-trained engineer has an advantage over his professional brother who "picks up" engineering. With a broad and deep foundation, there is no limit to the size of your superstructure and no limit to the speed with which you may erect it.

But the boy who starts in at engineering work when he leaves the common school is like one erecting a building and putting the foundation under it as he goes along. The job is not impossible, given patience and perseverance enough, but it takes a lot of both. Progress is slow, and the chances are that the man will be satisfied finally with a modest structure. Besides, foundations put in in this way are never quite as strong, never quite as reliable, as those built in the regular way. Sometimes such foundations fail and down comes the building.

The business of the engineering college, then, is to lay a broad, secure foundation. I am not objecting, mark you, to schools of a different sort. There is room and need for correspondence schools, for night schools, for industrial schools, for schools that may give special instruction in special fields. But if you aim to give an education to young men that will best fit them for high and responsible positions in the engineering world, then you must make your training a broad foundation.

And let me carry the simile one step further. You will find great difficulty in laying a secure foundation in a deep swamp or in fathomless quicksand. It will be a far better foundation if underlaid by rock or hardpan. So if you want to build a good foundation of engineering education, you must have to start with a boy of proper mental and moral and physical make-up. Now how will you restrict your work to such boys? That is, I think, one of the most difficult problems which our American colleges have to solve.

They are trying to solve this problem by raising their entrance requirements. They are trying to solve the other problem, how they may send out only high-class men into

the profession, by increasing the work of the college course. These are probably necessary changes; and yet I want to sound one note of warning:

There is danger, I believe—and I am not alone in this belief—that you may shut out of your engineering courses boys who have natural abilities which fit them for success as engineers and yet are deficient in some branch of study, perhaps mathematics or the languages.

I do not underestimate the value to an engineer of either of these branches; yet I feel that they have been often overestimated in the framing of our engineering courses.

There is danger, if you place your emphasis too much on purely scholastic attainments in your engineering schools, that you may raise up a generation of scholastic engineers, expert in theory but weak in its practical application. The mathematical side of the profession and even the research laboratory have been, if anything, overdone already. We must lay broader foundations than these typify if your graduate is to successfully compete with his rival, educated in the school of hard knocks. A broader training than this is needed if your engineer graduates are to meet the demands of this twentieth century.

Do you say, what are these demands? I want to impress upon you that the country to-day needs engineers of high type as it never has needed them before. Few realize the enormous change that has taken place in the relations between the engineer and the public. Go back less than a century—no longer ago than the lifetime of men still living—and you find the engineer almost unknown. Civilization and industry knew his prototype—the millwright, the builder, the miner; but their art was the art handed down by tradition, crusted over with superstition and error. The application of science and the scientific method to industry had barely begun.

Go back half a century and we have the beginnings of engineering: the railway, the steamship, the development of the mine and the waterfall. There were great men among the engineers of those pioneer days. We do well to honor their achievements. Yet the problems of that day, seen in our present light, were simple. The engineer was a necessity in very few industries. His art was not yet so complicated that it could not be mastered by the diligent student with little aid in the way of text-book or teacher.

But the period since the civil war, and particularly the latter half of that period, have seen social, economic and industrial revolutions, such as the world has never before witnessed. Civilization finds itself face to face with a multitude of perplexing problems. And a very large number of these problems are so interwoven with our industrial development that the engineer is needed to aid in their solution.

I have told you that engineers are needed to effectually solve the problem, "What is worth while." Is it worth while to spend two hundred million dollars to build one kind of lock canal at Panama, or three hundred million dollars to build the one we are now completing, or five or six hundred millions to build a sea-level canal? Is it worth while for the government to spend half a billion dollars on waterway improvements? Is it worth while for a state to spend a million or ten millions on good roads? How much ought a city to spend on sewage disposal, on the purification of its water supply, on lighting its streets?

I know engineers who shirk these questions, who say that the engineer should take a humble back seat while the statesman, the lawyer, and—if you please—the ward alderman decide these questions.

I tell you, gentlemen, this is a huge mis-

take. Our statesmen and lawyers and aldermen—even when they are honest and well-meaning—are sadly lacking in knowledge, except it be that little knowledge which is proverbially so dangerous.

For lack of wise engineering leadership the public is being led to-day toward many an unwise and wasteful expenditure. Men are going up and down the land to-day fostering fallacies and errors—errors which will directly affect our national welfare unless good sense and good judgment can be invoked to correct them.

No student of history can fail to be impressed with the importance to a people of able leaders. The prosperity of our own favored nation rests no more certainly on natural resources and on an intelligent and law-abiding people than it rests on wise leadership. The opportunity for leadership is open to the engineer. His technical knowledge is essential to the wise solution of public problems. Can he couple with his technical knowledge those other qualities which are essential if the public is to be safely guided?

And what are some of the qualities? Well, I would name first of all what I may term the judicial spirit. An engineer has no business to be governed by prejudice or partisanship. His sole object ought to be to find where the truth lies. He must constantly make choices in his daily work, and sound judgment in such choices is a first requisite. Of course he must have the knowledge on which to base a judgment; and yet when I am asked to recommend an engineer for large responsibilities, I look first of all for a man of broad mind, one who is able to weigh matters fairly and judge without prejudice. Even though such a man be compelled to rely on others for some part of the technical knowledge required, he is a safer counselor by far than a man of small caliber, though the latter be loaded to the muzzle with facts and theories.

The public has some reason for distrusting the judgment of so-called experts. If your expert has been a man of one idea too long, there is danger that his grasp of broad principles may be deficient and that his judgment may be warped.

Can you develop in your students who go out from this institution those qualities of mind and heart and character which will in later years ripen into sound judgment? If they gain such development from their college training they will gain something much more rare and valuable than knowledge of hydraulics or expertness in the testing laboratory.

Does it seem to you impossible to cultivate in your college course such personal qualities as the judicial spirit? I grant you that a proper mental equipment in the student is essential at the start; but given that, ought not the college years—the formative period of a man's life—to be effective in cultivating just such qualities? Do not our American colleges and universities miss their highest opportunity if they fail to develop in their students a broad outlook, fair-mindedness, keenness to discern error, love of the truth?

I have emphasized the need of engineering leadership. But the essential to leadership is the ability to deal with men. Your engineer may be a master of professional knowledge. He may have even the good judgment necessary for its application; but if he can not meet men face to face and hold his own with them, his professional ability will not win him the highest success.

Every engineer of long experience knows that the ability to write a clear report or a strong letter, to speak forcibly and convincingly, either to one man alone or an audience of hundreds—ability to do things like these is as valuable to an engineer as technical knowledge. Training in writing and in speaking is being emphasized more and more in our engineering courses.

And there are other qualities that make for leadership: tact—the combination of good judgment with good taste in dealing with others; self-confidence without self-conceit; a personality that attracts men, wins their confidence, holds their loyalty. It is qualities such as these that make the leader of men. It is such choice qualities as these that the atmosphere of our universities ought to develop in their students. Was it not with such high ends in view that our universities were founded?

Your splendid new building has higher purposes than a mere mill. You will not rate its success in dollars and cents of annual profit. And I want to protest against the too common standard by which we rate the success of men. You tell me that this graduate holds a $25,000 position, that another owns a rich copper mine and a third is president of a colossal trust. Have they achieved success? Very likely; but why not apply to them the same standard that we apply to your university?

The true measure of success, alike for the university and for its graduates, is the test of public service.

I know an engineer who has through long years guided the destinies of a great city, saved to its taxpayers untold millions of dollars, fostered its development in a way that will benefit generations yet unborn.

I know an engineer who dared to risk his professional reputation and his life to uncover fraud upon the commonwealth and to punish the guilty.

I know an engineer who has turned a barren desert into fruitful farms, has made possible prosperity and happiness to thousands and tens of thousands.

It is true that the public seldom appreciates the value of such services as these, and those who render such service often receive only meager reward; and yet I tell you that it is achievements like these that best deserve the name of success.

Shall we not then dedicate your new building to the culture of such high ideals? Within its walls may all noble traditions, all honorable standards, be fostered and upheld. May those who go forth from its influences carry with them a rich spirit of loyalty—loyalty to the public welfare, loyalty to their city, their commonwealth, their country. So will they justify those who to-day dedicate this building to public service.

CHARLES WHITING BAKER

THE NEW COLLEGE OF ENGINEERING, AN OPPORTUNITY[1]

A GREAT opportunity is before us. Through the generosity of Mrs. G. F. Swift and Mr. Edward F. Swift an excellent building for the new College of Engineering has been erected and its maintenance provided for. The board of trustees has determined to furnish the necessary funds to develop the new college. It will start with all the advantages, and they are many and not easily measured, of being a new department of an old and prosperous university, rather than a new, separate organization. Those persons at Northwestern who have fostered for years the idea that engineering should be taught at this university have had high ideals for the new college which have already helped it. The position of the new College of Engineering, within easy reach of one of the greatest centers of commerce and industry in the world, will furnish its students and professors unusual opportunities to keep in touch with the practising engineer. The new College of Engineering is being started at a time when the methods of engineering education are rapidly changing and developing. This is, therefore, an opportune time for it, if properly guided, to take and

[1] Address delivered at the dedication of the new College of Engineering of Northwestern University by the director-elect.

to hold one of the leading positions in the progress of engineering education. It is much easier for a new organization to develop along new lines than for an old organization to learn new ways.

In order to utilize well this great opportunity it is important that we should have a reasonably well-defined ideal toward which to strive. The ideal should be one from which effective working plans may be developed. To work without an ideal is to invite disaster from the changing currents of general tendencies and of personal opinions, and the strong deep currents of prejudice, or to invite disaster upon the shallows of undirected effort. To choose too high an ideal, one toward which we can not make considerable progress in our approach, is to provide for the formation of working plans which will be ineffective, discouraging to the workers, wasteful of effort and resources.

We might take it as our task to convert the high-school graduates who come to us as freshmen into men who will leave these grounds five or six years later as engineers fully trained and completely equipped mentally for their life work. This ideal can not be even approximately attained. To adopt it would lead to misdirected effort and to wasted opportunities.

Instead, our ideal should be so to train these young men in college that they will be capable of becoming engineers, and will have a tendency to become great engineers. We may hope to make a reasonably close approach to this ideal. We may hope to lay such a foundation of motives, of methods of thought, of principles which have been mastered, and of acquired information, that our graduates may, with accumulated experience and strength acquired by effort, become good engineers ten years after commencement, and in the unusual cases become great engineers within twenty of service.

Having this as our ideal, some of the general features of our working plans will follow naturally.

As it is not our purpose to attempt to graduate fully equipped engineers, we need not attempt to give each student special training in the particular narrow branch of engineering which he expects to follow. We need not attempt to teach the future railway engineer all the minutiæ of that occupation. We need not try to give to the future sanitary engineer all the specific information needed in his chosen line. As our purpose is to equip the graduate for unlimited growth as an engineer, rather than for the greatest immediate usefulness, it is obvious that we should put the emphasis in our teaching strongly upon the fundamentals which are the basis of the specialization in engineering, upon mathematics, chemistry, physics and mechanics.

So, too, in selecting the purely engineering courses which are to be given, each should be examined to ascertain the extent to which it is fundamental, the extent to which it deals with principles of broad application, rather than with principles applicable in a narrow field only, or with mere engineering information. A selection among engineering courses must be made, for it would probably require at least eight years in college for any one student to take all of the different courses now offered to undergraduates in colleges of engineering.

In teaching the broad principles which underlie engineering, in passing to the student that well-organized knowledge contained in the text-books and treatises on engineering which has aptly been called concentrated experience, the college has great advantages over the school of experience. On the other hand, skill, special knowledge and that familiarity with details which is a part, but not all, of experience, may clearly be best obtained outside the college, in the practise of engineering.

These considerations indicate approximately how to make the difficult decisions as to the amount of shop work, laboratory work and drafting which should be put into our curriculum. These courses serve in part one purpose, to illustrate principles, to make them concrete and thereby both to strengthen the grasp of the student upon the principles and to increase his interest in them. These courses, especially if made extensive, also serve another purpose, namely, to develop some skill and judgment in the manipulation of instruments, tools and apparatus. In accordance with our ideal, we should endeavor to stop when the first purpose has been accomplished. To endeavor to accomplish the second purpose also by more shop work, laboratory work and drafting during the college years will necessarily crowd out other courses in lines in which teaching may be done much more effectively in college than out of it.

The student should, however, be encouraged to engage in practical work connected with engineering, during his summer vacations. He may gain from this, in somewhat the same manner as from his first experiences after graduation.

In the statement of our ideal we have acknowledged that the embryo engineer has much to learn after he leaves college and before he becomes a full-fledged engineer. It follows, therefore, that it will be a mistake to keep him too long in college, just as truly as it will be a mistake to turn him out too soon, with too little training. With each year added to his life, the man tends to become less quick to learn new ways, less keen to profit by new experiences. We should not delay unnecessarily the date on which our graduate begins his work in the world. While he is in college he is surrounded by men who are endeavoring to teach him. He has put before him organized knowledge, carefully arranged and carefully presented. As soon as he steps out of college, or at least as soon as he rises above the lowest rank in his profession, the knowledge which it is most important for him to acquire is that which lies outside the field of well-organized knowledge. It comes to him in chaotic fashion. His fellow workers and his official superiors have but little interest in helping him to learn, and have still less activity in that line. With each additional year the young man stays in college, it becomes more difficult for him to adjust himself to this radical change in conditions when he goes out.

For the present, we have adopted a five-year course for engineers. Past experience in colleges of engineering shows that a four years' course is too short. The considerations just touched upon should lead us to examine with care any other considerations which seem to indicate that the course should be extended to six years.

The adopted five-year course for engineers is so arranged and provides for such liberal training that at the end of the first four years the successful student will have fulfilled all the requirements for, and will receive, the degree of bachelor of science from the College of Liberal Arts. An engineering degree will be granted at the end of the fifth year.

We have adopted as our ideal the proposition that we are to train engineers for the greatest average effectiveness in the first year after graduation. We should, therefore, avoid sending out our graduates handicapped by ignorance of men. The young engineer, or the old unsuccessful engineer, so long as he remains in such a minor position that he has no official subordinates and never needs to take the initiative, is but little handicapped by ignorance of men. But as soon as he begins to rise, and in proportion to the extent to which he must necessarily depend on those below him for details and for loyalty, on those around him for cooperation, and must

be trusted by those above, his progress is dependent upon knowledge of men. Cases are not infrequent in the engineering world in which the upward progress of an engineer is absolutely stopped by his clumsiness in dealing with men, even though he has great skill in dealing with materials and forces. It is our duty to teach our future engineers not only about forces and materials, but also about man and his ways, to bring it before them with emphasis that their future success in utilizing their engineering knowledge and skill depends upon their ability to work with men, among men and through men.

In the College of Engineering we may expect certain difficult problems to be ever present, intertwined with a multitude of other problems. The success of the college depends largely upon our success in solving these problems which are easily overlooked and neglected because of their familiarity. I intend to suggest but three examples.

Language is one of the important tools of an engineer. He must ordinarily do his work through others. He must have the power to convince. He must have the ability to use English accurately and effectively or be handicapped even in his strictly engineering work. One who acquires the ability to speak and write accurately and well, usually secures with it the power to think accurately. How can we best help the student in his college days to acquire the ability to speak and write well? This is a problem common to all colleges and to all universities. To one who deals much with recent graduates, it is discouragingly evident that but mediocre success has been attained in universities in solving this difficult problem.

It is a comparatively easy matter to lead a student along a given line of thought, but how can the student be trained to think for himself? That is one of the exceedingly difficult problems which confront us in the College of Engineering in common with all parts of the university.

We should aim, in the College of Engineering, to give our students a broad training, yet we desire to give them thorough training along certain lines. How is the broadening to be secured? Is it to be gained from certain courses intended for that especial purpose, or is it to be secured by the manner of teaching each course, even technical courses? This, again, is a problem common to nearly all, if not all, parts of the university.

The real success of the College of Engineering is dependent upon the solution of ever-present problems of which these are but examples. Because of the existence of numerous problems of this character which are common to the whole university, the College of Engineering gains strength from being a part of Northwestern University, rather than a separate institution. Because the engineer has a peculiar point of view, and the courses in engineering have some special advantages in connection with certain of these universal problems, the College of Engineering may hope in time to contribute a share toward the solution of these problems in this university.

Let us adopt as the motto of the College of Engineering the words, "Culture for usefulness." Let us put the emphasis strongly on the last two words. The first word alone may lead one astray, but the three together are a sure guide. The attempt to gain culture for the purpose of increasing one's usefulness in the world is essentially unselfish. In setting this motto before our students and in thus suggesting that they are to seek culture, not primarily for themselves, but in order to increase their usefulness in the world, usefulness of the broadest kind in the great united struggle of man for progress, we shall be setting before them an ideal which includes all others, an ideal which urges one

to the broadest attainable culture, in college and afterwards, an ideal which is inspiring and invigorating to any one who realizes its meaning.

We are here to-day to dedicate a building to engineering education. In a deeper and better sense, we are here to dedicate ourselves to the highest and best use of the great opportunity which the building represents, an opportunity to give an uplift to the ideals and to increase the usefulness of thousands of young men who are to enter their life work through that building, an opportunity to help in raising the standard of engineering education, an opportunity to help in making American universities of greatest real service to American people.

JOHN F. HAYFORD

NORTHWESTERN UNIVERSITY

COMPARATIVE ENROLMENT OF STUDENTS OF ENGINEERING

IT is generally supposed that the attendance on the engineering schools of our country continues to show the rapid gains that have marked their development during the past ten or fifteen years, and while at the majority of the institutions the enrolment of to-day compared with that of say five years ago would exhibit a healthy increase, an analysis of the accompanying table proves that a reaction is apparently beginning to set in, at least at a number of the institutions. It will be seen from the table that the present total attendance of engineering students at twenty-four representative institutions shows an increase over last year of only one hundred and ninety-one students, or one of 1.15 per cent. The figures given include students of engineering, mining and metallurgy, and chemistry, but are exclusive of students of architecture (with one or two exceptions), agriculture, forestry, biology, etc. It should be noted that a number of institutions (for example, the Massachusetts Institute of Technology) have one or more of these last mentioned courses, and that the figures in the table do not, therefore, represent in every case the *total* registration of the school. In some instances (for example, Michigan) graduate students are included, in others (for example, Columbia) they are not; most of the institutions submitted the spring registration, but in a few cases the fall figures are given, and there may be several other minor differences, yet in spite of these discrepancies, the table as given will convey a sufficiently accurate idea of the most recent changes in engineering attendance. Owing to the regulation requiring a baccalaureate degree for admission to the school of applied science, which has recently become operative at Harvard, the figures of this institution have been omitted, since a comparison would be somewhat misleading. Thirteen of the institutions exhibit a gain in attendance over last year, while eleven show a loss. It is interesting to note that of the independent schools six show losses in attendance as compared with last year, whereas only five of the schools connected with universities have experienced a decrease in enrolment since 1907–8, while eight schools connected with universities and five independent schools show gains.

Institution	Registration		Increase or Decrease	
	1907–08	1908–09	No. of Students	Percentage
Cornell University	1,638	1,727	89	5.4
Purdue University	1,398	1,364	—34	— 2.4
University of Michigan	1,325	1,335	10	0.7
Massachusetts Institute of Technology	1,259	1,297	38	3.0
University of Illinois	1,059	1,081	22	2.1
University of Wisconsin	940	906	—34	— 3.6
Ohio State University	839	888	49	5.8
University of California	794	818	24	3.0
Yale University (Sheffield Scientific School)	788	793	5	0.6
Columbia University	618	717	99	16.0
University of Minnesota	647	677	30	4.6
Rensselaer Polytechnic Institute	609	660	51	8.4
Lehigh University	662	646	—16	— 2.4
Armour Institute	521	518	— 3	— 0.6
Worcester Polytechnic Institute	462	487	25	5.4
University of Missouri	466	444	—22	— 4.7
Case School of Applied Science	479	431	—48	—10.0
University of Nebraska	439	396	—43	— 9.8
Stevens Institute of Technology	435	390	—45	—10.3
Colorado School of Mines	349	380	31	8.9
Michigan College of Mines	266	277	11	4.1
University of Iowa	239	218	—21	— 8.8
Rose Polytechnic Institute	223	206	—17	— 7.6
Tulane University	145	135	—10	— 6.9
Total	16,600	16,791	191	1.15

RUDOLF TOMBO, JR.

SCIENTIFIC NOTES AND NEWS

BY unanimous vote of its council the American Psychological Association will hold its next meeting in Boston in affiliation with the American Association for the Advancement of Science.

AT the colloquium of the American Mathematical Society, to be held at Princeton University, September 15–17, courses of lectures will be delivered by Professor G. A. Bliss, on "Fundamental Existence Theorems," and Professor Edward Kasner on "Geometric Aspects of Dynamics." Professor J. H. Jeans having resigned his position at Princeton, the course of lectures announced to be given by him has been cancelled.

IN connection with the Darwin centenary, at Cambridge, it is proposed to confer the degree of doctor of science upon E. van Beneden, professor of zoology in the University of Liège; Robert Chodat, professor of botany in the University of Geneva; Francis Darwin, F.R.S., of Christ's College; Karl F. von Goebel, professor of botany in the University of Munich; L. von Graff, professor of zoology in the University of Gratz; H. Höffding, professor of philosophy in the University of Copenhagen; J. Loeb, professor of physiology in the University of California; E. Perrier, director of the Natural History Museum, Paris; G. A. Schwalbe, professor of anatomy in the University of Strassburg; H. von Vöchting, professor of botany in the University of Tübingen; H. de Vries, professor of botany in the University of Amsterdam; C. D. Walcott, secretary of the Smithsonian Institution; E. B. Wilson, professor of zoology in Columbia University, and C. R. Zeiller, professor of paleobotany in the École Nationale Supérieure des Mines, Paris.

MR. PHILLIP FOX, of the Yerkes Observatory, has been nominated by the Chicago Astronomical Society, to be director of the Dearborn Observatory and professor of astronomy in Northwestern University in succession to the late Professor Hough.

PROFESSOR C. H. EIGENMANN, professor of zoology and dean of the Graduate School of the Indiana State University, has been appointed curator of ichthyology at the Carnegie Museum, Pittsburgh, with the understanding that his appointment will not interfere with his duties in connection with the Indiana State University. Professor Eigenmann will work up the large collections belonging to the museum at his home in Indiana, and will during the summer months devote a portion of his vacation to directing others in arranging the collections systematically.

DR. VICTOR STERKI, of New Philadelphia, Ohio, known for his work on the North American *Pupidæ* and allied families, has been appointed an assistant in conchology at the Carnegie Museum. Dr. Sterki's collection became the property of the museum some years ago.

MR. E. DANA DURAND, deputy commissioner of corporations, has been appointed director of the Census to succeed Mr. S. N. D. North.

PROFESSOR SIMON NEWCOMB has left the Johns Hopkins Hospital and returned to his home in Washington.

PROFESSOR DÜNKELBERG, formerly director of the Agricultural Academy at Poppelsdorf, has celebrated his ninetieth birthday.

IN addition to the list of delegates to the Darwin celebration of Cambridge University, printed in a recent issue of SCIENCE, the National Academy of Sciences will be represented by Dr. George E. Hale, of the Mount Wilson Solar Observatory, and the Massachusetts Institute of Technology by Professor William T. Sedgwick.

MR. S. F. EMMONS, of the U. S. Geological Survey, has been appointed a delegate to represent the National Academy of Sciences at the five hundredth anniversary of the foundation of Leipzig University, which will be celebrated on July 28 to 30, 1909.

MR. W. BATESON, F.R.S., will give the Huxley lecture at Birmingham this year.

MR. C. G. ABBOT, director of the Smithsonian Astrophysical Observatory, has left Washington for Mt. Wilson, California, to continue there during the summer and fall observations in progress for a number of years as to the intensity of the sun's rays and the effect of any variation in them upon the earth.

There has recently been erected on Mt. Wilson a small permanent observatory especially designed for this purpose. Here Mr. Abbot, with the assistance of Dr. L. R. Ingersoll, of the University of Wisconsin, will study during the next few months. The expedition will also spend some time on the summit of Mt. Whitney, 14,500 feet high, where the Institution plans to erect in July a shelter of stone and steel for the use of scientific investigators engaged in researches of any kind for which high altitudes, dry air and clear skies are desirable.

RALPH S. TARR, of Cornell University, will spend the summer in making a further study of the glaciers of Alaska. He will be accompanied by Professor Lawrence Martin, of the University of Wisconsin.

PROFESSOR OTTO NORDENSKJIOLD and Dr. Hilmar Skoog will this summer conduct explorations in Greenland.

DR. ALEXANDER PETRUNKEVITCH, honorary curator of arachnida in the American Museum of Natural History, will spend July and August collecting arachnida and other forms of insect life in Texas, Mexico and Guatemala.

PROFESSOR J. HORACE FAULL, of the University of Toronto, has been granted leave of absence for the academic year 1909–10. He is continuing his studies on the cytology of the Ascomycetes, particularly of the Laboulbeniaceae at the Laboratories of Cryptogamic Botany, Harvard University.

SUPERINTENDENT GEORGE MCKERROW, of the department of farmers' institutes in the College of Agriculture, University of Wisconsin, has sailed for England to attend the annual meeting of the British National Sheep Breeders' Societies, held in connection with the Royal Stock Show, June 21, at Gloucester, England. Mr. McKerrow, will deliver the annual address on "How We Can Improve the Sheep Industry."

A PORTRAIT of the late Carroll D. Wright, president of Clark College, has been presented to the college, and will be unveiled at the memorial services to be held on July 14. The speakers will include President G. Stanley Hall for the university and Dean Rufus J. Bentley for the college.

DR. G. A. GIBSON, of Edinburgh, has undertaken to edit the medical and scientific papers and articles of the late Sir William Tennant Gairdner, and to preface the volume with a biography.

A MONUMENT in honor of Michel Servetus will be unveiled at Vienna in the department of Isère on August 14. Professor J. C. Hemmeter, of Baltimore, will make one of the addresses.

M. J. IORNS, Ph.D. (Cornell), who has been for several years horticulturist of the Porto Rico Experiment Station at Mayaguez, died of typhoid fever in San Juan on May 17.

DR. CHARLES BURNHAM PORTER, formerly professor of clinical surgery at Harvard Medical School, died on May 21 at the age of sixty-nine years.

DR. WILLIAM WIGHTMAN, of the Public Health and Marine Hospital Service, died at Guayaquil, Ecuador, on May 17, from yellow fever.

MR. GEORGE C. EDSON, of St. Alban's, Vermont, known for his work on the geology of the state, died on May 24.

DR. BINDON BLOOD STONEY, F.R.S., a distinguished Irish engineer, died at Dublin, on May 5, in his eighty-first year.

M. JULES ERNEST NAVILLE, formerly professor of philosophy in the University of Geneva, died on May 27, at the age of ninety-two years.

DR. HEINRICH VON RANKE, professor of diseases of children at the University of Munich and known also for his work on hygiene, agriculture and archeology, has died at the age of seventy-nine years. Professor Johannes Ranke, the eminent anthropologist and physiologist, of the University of Munich, is his brother, and Leopold von Ranke, the historian, was his uncle.

THE deaths are also announced of Dr. Oskar Emil, emeritus professor of physics at Breslau, at the age of seventy-four years; of Dr. Hermann von Stahl, professor of mathematics at Tübingen, at the age of fifty-six years; of Dr. Alfred Partheil, professor of pharmaceutical chemistry of Königsberg, aged forty-eight years, and of Dr. Otto Biermann, pro-

fessor of mathematics at Brünn, at the age of fifty-one years.

THE seventh International Congress of Applied Chemistry opened in London on May 27, with some three thousand members in attendance. At the opening exercises Dr. Harvey W. Wiley, of the U. S. Department of Agriculture, replied for the United States.

THE ninety-second annual meeting of the Société helvétique des sciences naturelles will be held at Lausanne on September 5–8, under the presidency of M. Henri Blanc.

THE annual congress of the Southeastern Union of Scientific Societies will be held at Winchester on June 9–12, under the presidency of Dr. Dukinfield H. Scott, F.R.S.

AT the National Conference on Criminal Law and Criminology held in celebration of the fiftieth anniversary of the Northwestern University School of Law at Chicago from June 7–9, the Honorable Charles S. Deneen, governor of Illinois, has consented to act as temporary chairman. In order to facilitate organization, the committee of organization will nominate (with his consent) for permanent chairman, James Hagerman, Esq., of St. Louis, sometime president of the American Bar Association. The committee will also nominate for temporary chairman of the Section on Treatment (Penal and Remedial) of Offenders, Dr. E. T. Devine, professor of social economy in Columbia University, New York; for temporary chairman of the Section on Organization, Appointment and Training of Officials, Dr. Edward A. Ross, professor of sociology in the University of Wisconsin, Madison, Wisconsin; for temporary chairman of the Section on Criminal Law and Procedure, William E. Mikell, Esq., professor of law in the University of Pennsylvania, Philadelphia.

THE Chicago Chapter of the Sigma Xi Society held its biennial election of officers on May 25, 1909, which resulted as follows: *President*, E. H. Moore; *Vice-president*, R. R. Bensley; *Secretary and Treasurer*, Oscar Riddle; *Corresponding Secretary and Councilor*, Julius Stieglitz. The paper of the evening was presented by Mr. Bailey Willis, U. S. Geological Survey, upon "China, the Land and the People."

THE Iota Chapter of the Alpha Chi Sigma Chemical Fraternity was installed at Rose Polytechnic Institute on May 22 by Mr. L. S. Palmer, of the University of Missouri; Dr. J. H. Mathews, of the University of Wisconsin, and Mr. O. C. Stanger, of the University of Illinois. The following men constitute the active members of the new chapter: H. J. Bangert, H. Isenberg, R. S. Wilson, J. V. Davidson, R. L. Flood, F. W. Kroemer, Jr., F. Cohen, J. A. Hepp and D. M. Hubbard. Dr. Carl Leo Mees, president of the institute, and Dr. John White, professor of chemistry, were made honorary members. A banquet followed the installation.

THE launching of the Magnetic Survey yacht *Carnegie* will take place on June 12, 1909, 2:30 P.M., at the Tebo Yacht Basin Company, foot of 23d Street, Brooklyn, N. Y. Miss Dorothea Louise Bauer, daughter of Dr. L. A. Bauer, director of the Department of Terrestrial Magnetism, has been chosen by the executive committee of the Carnegie Institution of Washington to perform the christening ceremony.

IN order to put a stop to the serious damage done by persons uprooting ferns and wild plants growing in hedgerows and on commons, etc., in the county of Surrey, England, the Surrey County Council has made the following by-law: "No person shall uproot or destroy any ferns or other wild plants growing in any road, lane, roadside waste, wayside bank, or hedge, common, or other public place, in such a manner or in such quantities as to damage or disfigure such road, lane, or other place. Provided that this by-law shall not apply to persons collecting specimens in small quantities for private or scientific use. A person offending against this by-law shall be liable to a penalty not exceeding £5."

UNIVERSITY AND EDUCATIONAL NEWS

MR. W. C. PROCTOR, of Cincinnati, of the class of '83, has offered to give Princeton University $500,000 for its graduate school on condition that an equal sum be subscribed within a year.

The legislature of Pennsylvania at its last session appropriated three hundred and twenty-five thousand dollars to the University of Pittsburgh to be expended for new buildings and maintenance.

By the late Dr. F. W. Draper, Harvard University receives an unrestricted bequest which it is believed will amount to $100,000.

The Massachusetts legislature has appropriated $80,000 for the erection of a fireproof building for the departments of zoology and entomology, at the Massachusetts Agricultural College.

The New York legislature appropriated $57,000 for the use of the Agricultural School of St. Lawrence University.

The Tennessee legislature has passed a bill giving 25 per cent. of the state's revenues for education, 7 per cent. being for the university and experiment station.

The late Mr. James Duncan has bequeathed a portion of his estate, calculated to amount to about $300,000 for the establishment of a school of industrial art in Dundee, Scotland.

The new Institute of Physiology at University College, London, will be formally opened on Friday, June 18, by the Hon. R. B. Haldane, secretary of state for war. The funds for the building of the institute were provided by Mr. Ludwig Mond and Dr. Aders Plimmer and by a bequest of the late Mr. Thomas Webb.

Dr. Samuel Avery, head of the department of chemistry in the University of Nebraska and acting-president since the resignation of Dr. Andrews, has been elected president of the institution.

Dr. Ernest Merritt, professor of physics, has been appointed dean of the graduate school of Cornell University.

At the University of Minnesota, Professor John Zeleny has been appointed head of the department of physics to succeed Dean Frederick S. Jones, who has been called to the deanship of Yale College; Assistant Professor Anthony Zeleny has been appointed professor of physics, and Dr. W. F. Holman, of Worcester Polytechnic Institute, instructor in physics; and a new instructorship not yet filled has been created. Assistant Professor H. A. Erikson returns to the department after a year's absence at Cambridge, England, and Dr. A. F. Kovarik has obtained a leave of absence for study abroad.

Dr. H. H. Horne, professor of philosophy at Dartmouth College, has been appointed professor of the history of education at the New York University, to succeed the late Professor Gordy.

Dr. Charles T. Burnett, of Bowdoin College, has declined a call to the chair of psychology at Amherst College.

Mr. C. T. Brues, of Milwaukee Public Museum, has been appointed instructor in economic entomology at Harvard University.

Miss Mabel Bishop, fellow in zoology in Smith College, has been appointed instructor in biological science in the Woman's College of Baltimore.

Dr. J. B. Leathes, of London, has been appointed professor of chemical pathology in the faculty of medicine of the University of Toronto.

DISCUSSION AND CORRESPONDENCE

TO THE PHILOSOPHIC ZOOLOGIST

Whether definite variations are by chance useful, or whether they are purposeful are the contrasting views of modern speculation. The philosophic zoologist of to-day has made his choice. He has chosen *undirected* variations as furnishing the materials for natural selection. It gives him a working hypothesis that calls in no unknown agencies; it accords with what he observes in nature; it promises the largest rewards.

The above paragraph is a quotation from the address of my friend and colleague, Professor T. H. Morgan, delivered in the Darwin course at Columbia University, February 26. It is interesting as showing the absolute divorce between the zoological and paleontological observer, a matter to which I have called renewed attention in my Baltimore address recently published in "Fifty Years of Darwinism."

If the word "undirected" implies fortuity, as I presume it does, it is an interesting future possibility that the theory of the building up

of adaptations out of the natural selection of undirected variations, to use my colleague's language, may prove to be a dogma quite as unsupported by facts as the Lamarckian dogma of the inheritance of acquired characters. I long ago pointed out that a very large number of new characters in the hard parts of mammals are adaptive in direction from the beginning; I am very far from saying that *all* new characters are adaptive in direction; I only make this statement as to those characters I have had the opportunity of repeatedly observing.

I now challenge the zoologists to produce a single instance of a series of animals in which adaptive characters are being accumulated through the *selection* of undirected variations, *i. e.*, of variations which are thoroughly mixed up, in which *there is no law evident.* Such a series has never been produced by any one. Of course I bar from this challenge orthogenic changes of character under environmental influences. I refer to the *pure* Darwinian hypothesis. The hypothesis is still as Darwin left it, an ingenious working theory, awaiting either experimental evidence or evidence of any kind. How long this assumption will pass muster as based on observation it is hard to say. We await some paleontological Weismann who will smite it hip and thigh as the zoological Weismann smote Lamarck's assumption.

While the "philosophic zoologist" of to-day has made his choice, the philosophic paleontologist has also made his choice. The latter certainly does not find direction in the old teleologic sense, but quite as certainly he finds no evidence of such fortuity as will justify the use of the word *undirected* as furnishing materials for natural selection. The materials for natural selection are furnished by the *ensemble* of an enormous number of characters, each of which is a unit pursuing its independent history and fluctuating and mutating and moving in direct lines under laws which the philosophic paleontologist has proof of, but totally fails to understand. Consequently he assumes the agnostic position that there is some principle, or principles of direction, or better—to use Professor Morgan's own words —"unknown agencies," still to be discovered other than the principle of order coming out of fortuity.

HENRY FAIRFIELD OSBORN

NELSON'S LOOSE LEAF ENCYCLOPEDIA.

TO THE EDITOR OF SCIENCE: In February an article was published in Nelson's "Loose Leaf Encyclopedia" upon the Messina-Reggio earthquake, the authorship of which was credited to Mr. Frank A. Perret and myself. In justice to Mr. Perret, however, it should be stated that he had nothing whatever to do with the preparation of the article beyond furnishing the one item pertaining to the height of the "tidal" wave at Messina which is duly credited to him. The insertion of Mr. Perret's name as joint author was done by the publishers of the encyclopedia without my knowledge or consent, but thus far I have been unable to obtain any correction of their error.

E. O. HOVEY

NEW YORK,
May 11, 1909

SCIENTIFIC BOOKS

General Physics. By HENRY CREW. New York, The Macmillan Co. 1908.

A Text-book of Physics. Edited by A. WILMER DUFF. Philadelphia, P. Blakiston's Son & Co. 1908.

The publication of these two excellent text-books designed for college classes in physics illustrates the general dissatisfaction among college professors of physics with both existing text-books and accepted methods. There are many difficulties inherent in the teaching of physics and there are many points concerning which the best teachers are to a certain degree undecided. As physics is taught at the present time in most American colleges the time devoted to it is one year during each week of which there are three hours of lectures or class work, accompanied by five or six hours of laboratory work. In this time a student is supposed to cover the field of elementary mechanics, properties of matter and physics proper, including heat, light, etc. Within recent years a demand has arisen for text-books which should have more or less refer-

ence to the different classes of students following the course, the point being that students looking forward to engineering ostensibly need a text-book different in character from that best fitted for other students. The difficulties of satisfying these requirements by any one text-book are insuperable. At the very best the author must make certain compromises and must adapt his book to certain actual conditions, and to the classes with which he is most familiar. It is not an easy matter to prepare a text-book in physics which shall satisfy the obvious pedagogical requirements for physics as a subject in general education and at the same time meet the requirements mentioned above. It is not to be expected that all teachers of physics should feel satisfied with all text-books of physics, from the standpoint either of general purpose or of detail, but the two books under review are certainly admirable in many respects, and are sure to have a well-deserved popularity among American colleges.

The author of the present review is not certain as to the object of such an article. It certainly should not be to point out typographical errors, or even to refer to what may seem to him to be misstatements of facts or of theory. On the contrary, perhaps the best result may be secured by noting both the obvious facts concerning the book and the points by which each differs from other well known books.

Professor Crew's book is a beautiful piece of book-making; the paper, type, wood-cuts and binding are all that could be desired. It contains 515 pages, of which 182 are devoted to mechanics and properties of matter, 64 to wave motion and sound, 61 to heat, 115 to magnetism and electricity and about 100 pages, the rest of the book, to light. The balancing of the various subjects, as shown by this subdivision, is admirable. One would expect that this text-book would prove most satisfactory to any college class; the references to the historical development of the science are most interesting and inspiring; the various machines or experimental facts which are given as illustrations of the general theories are well selected and described with enthusiasm; in fact, the whole book is permeated with a certain charm thoroughly characteristic of all of Professor Crew's own enthusiasm as a teacher and investigator. Another excellent point about the book is the selection of problems. These contain not only useful arithmetical illustrations, but also questions which require the exercise of reasoning as apart from any use of formulæ or numbers. It is only in a few places that the author seems to introduce matter which is too far removed from the elementary character of the general book.

The text-book edited by Professor Duff is a compilation of seven sections prepared by different authors as follows: Mechanics, by Professor Duff himself; Heat, by Professor Guthe; Wave Motion and Sound, by Professor Hallock; Light, by Professor E. P. Lewis; Electricity and Magnetism, by Professor Goodspeed; Electromagnetic Induction, by Professor Carman, and Conduction of Electricity through Gases and Radioactivity, by Professor McClung.

In attempting to prepare a book in this manner there are no unavoidable difficulties provided the general editor is one who has certain executive powers, and certainly in this case the publishers are fortunate in having persuaded a man of Professor Duff's ability to assume the task. As is to be expected in such a compilation, there is a certain degree of inequality, but in this particular illustration it is reduced to a minimum. In fact, the work is admirably done from the standpoint of the general editor. The book contains 666 pages and is divided into the seven sections referred to; 177 being devoted to mechanics and properties of matter, 102 to heat, 45 to wave motion and sound, 143 to light, 154 to electricity and magnetism, including electromagnetic induction, 136 to conductivity of gases, etc. At the end of the various sections there are sets of problems which in the majority of cases are admirably selected. The illustrations are clear, but lack the charm of those of Professor Crew's book; the type and paper are satisfactory, although not so good as to demand special attention.

It is not easy to decide as to the class of students for which this book is designed, be-

cause in some ways the treatment is most elementary and in other chapters use is made of the calculus. The field covered is satisfactory on the whole, as is shown by searching in the various chapters for discussions of all the important general phenomena. It would not be difficult to refer to certain sections which might be omitted with profit, but on the whole there is little to criticize in this respect, for the rights of the individual teacher and author must be respected.

The success of any text-book in physics must be decided from its effect upon the mind of the students who use it. If they are taught by means of it to reason correctly, and if they learn a consistent view of the great phenomena of nature, it has accomplished its purpose. A great deal naturally depends upon the teacher, but certainly in the present case the authors of the text-book referred to above have done their full share. J. S. Ames

The Johns Hopkins University

A Manual of North American Diptera. By Samuel W. Williston. Third edition, illustrated. New Haven, Conn., James T. Hathaway. 1908. Price, $4.00 postpaid. Pp. 405, duodecimo, cloth.

The much-desired third edition of Dr. Williston's manual was actually published and some copies distributed about August 28, 1908, but on account of the absence of the author on a fossil-hunting expedition in western Texas only a few copies were sent out until about the end of the year. It has, therefore, received but little notice in reviews up to the present time.

The book, like the preceding editions, is designed largely for beginners. It contains an introduction, a treatise on the anatomy of diptera, suggestions as to methods of collecting, preserving and studying the insects, some general remarks on the principles of classification, a synoptic table of the families and a series of chapters on the families. These last-mentioned chapters each include one family, giving in uniform style the following topics: definition of the family, characters of the larvæ, habits of larvæ and adults (often at some length), and table of genera based on adult characters. In a few cases the larvæ are to some extent subdivided in a separate table. Several of the chapters are written partly or wholly by other entomologists.

The illustrations form a new and conspicuous feature of the work, numbering nearly a thousand. While recent entomological literature has been drawn upon to some extent, a large proportion of the figures are new and drawn by Williston himself, representing an immense amount of labor on his part.

In the preface, after mentioning the successive publications in which he had attempted to outline the classification of North American diptera, the author states that he feels his work in this line completed with the present publication. Perhaps, for this reason, he has allowed himself to express his views and even his feelings to a greater extent than in former editions. Many passages might well be quoted, either as illustrating generalizations derived from thirty years of strenuous scientific work, or to illuminate points of disagreement between the author and certain younger dipterists. A very few selections must suffice.

> Giantism in any group of animals is a specialization, and is, in general, an indication of approaching decadence. . . . No strong or dominant group of flies, like the Tachinidæ, Dolichopodidæ, Syrphidæ or Bombyliidæ, has ever had in the past a larger average bodily size than is found among their living representatives.

On the splitting of genera in the mosquitoes:

> I fear even Desvoidy's shade would turn pale with envy in the contemplation of some of the proposed genera of the modern culicidologists.

On the "mere collector":

> His labors are hardly more important than those of the microtomist who cuts up frogs' eggs and makes pictures of them.

In the matter of wing nomenclature the common system is wisely adhered to, while the Comstock (here called the Comstock-Needham) is illustrated in a page of wings. Unfortunately, the tabular exhibit of homologous terms is imperfect because Comstock's earlier designations are used. The fact that there are already three distinct forms of Comstock nomenclature in existence is an excellent rea-

son, if any were needed, for not introducing even the latest one into the manual.

In the classification of mosquitoes he expresses strong dissent from the process of continually subdividing the great central mass of the genus *Culex*, but naturally is not in a position to elaborate a system, and is therefore obliged to use one that is not much different from that of Dyar and Knab. In Cecidomyidæ, too, he finds too many genera, and adopts a current generic table only under protest. In Dexiidæ and Tachinidæ the tables were prepared by Professor C. F. Adams. Dr. Williston, wishing the criticism of a specialist on this difficult group, and being unable to secure the assistance of Mr. Coquillett, asked Mr. C. H. T. Townsend to prepare notes on the figures. This was unfortunate, as Mr. Townsend's ideas of genera are extremely radical; it naturally happened that his notes only serve to confuse the subject. He, however, seized the opportunity to erect a few new genera on the figures, which was the more out of place and uncalled for since he promised fuller descriptions in a forthcoming paper. Would that he had reserved his adumbrations in their entirety!

A few errors in typography and other mistakes are corrected in a brief appendix. Typographical or any other sort of perfection must not be demanded in a contribution offered as a gift to science after years of strenuous and wholly gratuitous effort. Professor Williston has acquitted himself well, and has given us a work which no one else in the world could have produced, one not approached in any other large order of North American insects. Nay, he has done still more—he has printed it practically at his own expense, and will not be reimbursed until almost the whole edition is sold. Because I happen to know this I wish the entomological public to understand how great their debt really is. And Professor Williston never occupied an entomological position in his life. He has given *himself* to science, and that is the greatest offering any man can make.

J. M. ALDRICH

MOSCOW, IDAHO

SCIENTIFIC JOURNALS AND ARTICLES

THE contents of *The Journal of Biological Chemistry* (Vol. VI., No. 2, issued May 10, 1909) are as follows: "On the Composition of Dilute Renal Excretions," by A. B. Macallum and C. C. Benson. Large volumes of water were ingested to increase rapidity of flow and decrease concentration of urine in order to diminish the reabsorption of water and salts in the convoluted tubules of the kidney postulated in Ludwig's theory of urine formation. Estimations of potassium and chlorine in very dilute urine revealed neither a proportionality between salt content of blood plasma and of urine nor a uniform ratio of potassium and chlorine excretion. Secretion of water and salts is therefore not a process of filtration, but is truly secretory; the secretory activity varies for each inorganic constituent. "On the Depression of the Freezing Point Due to Dissolved Caseinates," by T. Brailsford Robertson and Theo. C. Burnett. Casein combines with bases to form "neutral" and "basic" salts of definite composition which produce a definite measurable depression of the freezing point. Estimations indicate a molecular weight of "basic" caseinates of 1,400; of "neutral," 2,000. "The Cerebrospinal Fluid in Certain Forms of Insanity, with Special Reference to the Content of Potassium," by Victor C. Myers. Analyses show that changes in the composition of cerebrospinal fluid occur after death. Protein-phosphates, and especially potassium, are increased. The protein content in dementia paralytica is increased during life. "Human Pancreatic Juice," by Harold C. Bradley. Examination of human pancreatic juice showed an average specific gravity of 1010; alkalinity equal to $N/20$ — $N/10$ sodium bicarbonate; no definite relation between diet and enzyme content; no rennin, invertase or lactase; trypsinogen in all specimens, trypsin in 50 per cent. A study was made of the influence of various conditions upon the activity of lipase. "On a Modification of Lunge's Method for the Quantitative Estimation of Urea," by Clarence Quinan. Lunge's method (*Zeitschr. f. angew. Chem.*, 1890, p. 139) of reducing measurements of

gas volume to standard conditions applied to the estimation of urea in urine by the hypobromite method. "The Relation of Different Acids to the Precipitation of Casein and the Solubility of Cheese Curds in Salt Solutions," by J. L. Sammis and E. B. Hart. The amount of $N/10$ acid required to precipitate casein from a lime-water solution varies with the temperature, kind of acid and age of solution. The solubility of cheese curds in salt solution depends upon the kind of salt and the concentration. It is influenced by contact with acids. "An Endeavor to Account for the Transfer of Proteid in Inanition," by Albert Woelfel. An attempt to explain why some tissues waste more than others during inanition by comparison of autolytic and heterolytic digestions. Results negative. "Proceedings of the American Society of Biological Chemists," in session in Baltimore, December 28–31, 1908.

The Museums Journal of Great Britain for March describes "A Method of Mounting Eggs," by Raymond Bennett, in use in the Ipswich Museum; and Mrs. Roesler tells of "The Work of an Instructor in the American Museum of Natural History," whose work lay especially with children and teachers. There is a note on a "Conference on Indian Museums" at which eleven governments or states were represented and a variety of topics discussed.

The Zoological Society Bulletin for April is an Aquarium Number, devoted to things aquatic. It contains a description of "The Bermuda Aquarium," tells of "Frogs and Frog Raising," of the "Water-throwing Habit of Fishes in the New York Aquarium," of "The Solution of the Carp Problem" and "Angling and Water Pollution." Finally there is "A Photographic Study of the Ghost Crab."

The Museum News, of the Brooklyn Institute, is mainly devoted to a "Guide to the Exhibits Illustrating Evolution and the Preservation of Animals" and a "Guide to the Trees and Important Shrubs of Bedford Park."

The Bulletin of the Charleston Museum announces the beginning of a collection to illustrate the mineralogy of the middle and southern Atlantic states, to be known as the "Piedmont Mineral Collection."

BOTANICAL NOTES

It now turns out that the big cactus so common in Arizona, and which is a foot or so thick, and from fifty to sixty feet in height, is not a *Cereus* as had always been supposed. Under this generic name it had been known in books and reports as *C. giganteus*. A recent careful study of this plant by Drs. Britton and Rose has convinced them that its reference to this genus by Engelmann was erroneous, and they find that it is the type of a new and hitherto undescribed genus, which they name *Carnegiea* (*Jour. N. Y. Bot. Gard.*, Nov., 1908). Accordingly this striking cactus is hereafter to be known under the name of *Carnegiea gigantea* (Engelm.) Britt. and Rose.

Another genus has been segregated from *Cereus*, to which the name *Harrisia* has been given by Dr. Britton (*Bull. Torr. Bot. Club*, Dec., 1908). Three species from Cuba and Jamaica are now referred to this genus, and five new species from Cuba, Porto Rico, Haiti and the Bahamas are added.

A morphological paper of much more than ordinary importance recently appeared in the *Transactions of the Connecticut Academy of Arts and Sciences* (Vol. 14, pp. 59 to 170), under the title of "The Morphology of *Ruppia maritima*," by Dr. A. H. Graves. This plant is a slender branching aquatic, grass-like in appearance and belonging to the family *Potamogetonaceae*, which contains other genera and species of "pondweeds." After a morphological and ecological study of the vegetative organs, the reproductive organs are taken up in a most satisfactory manner, followed by a study of embryo, fruit, seed and seedling. Thirty-three text illustrations and fifteen large, full-page plates with 121 figures help to elucidate the descriptions. A bibliography of 98 titles closes the paper. In his closing chapter devoted to a summary of the relationships of Ruppia to other Potamoge-

tonaceae the author finds evidence of reduction from "some form similar to the present submerged Potamogetons, with *Zannichellia* and *Althenia* serving as examples of still further reduction."

IN the *Botanische Zeitung* for November 1, 1908, H. Bruchmann's paper, "Das Prothallium von *Lycopodium complanatum* L." adds materially to our knowledge of the gametophyte generation of this species. The tissues of the erect, tuberous gametophyte are shown to consist of a rhizoid-bearing epidermis; a layer containing endophytes; a layer of radially arranged palisade cells, and a large-celled central mass of parenchyma. Branching occurs, giving rise to increased areas for the sexual organs. Some of these prothallia are unisexual and others bisexual. The sexual organs are crowded into dense masses at the summit of the prothallium and are of the usual type of structure.

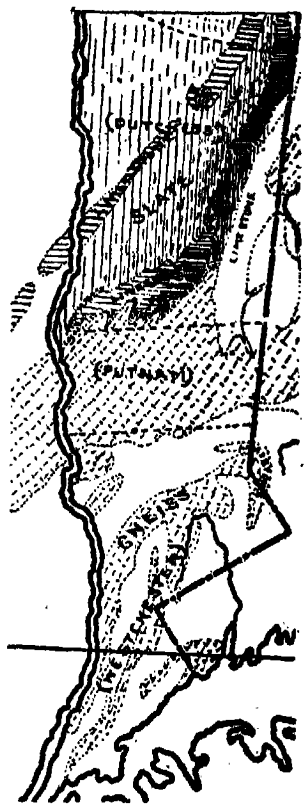
ALBERT MANN, expert in charge of special barley investigations in the Bureau of Plant Industry of the U. S. Department of Agriculture, makes a preliminary report of the results of his study of the problems of how to recognize the best grades of barley (Circular No. 16, issued November 25, 1908) in which he finds that "the diastatic and cytatic starch ferments are wholly the product of the scutellum and are secreted by its outer layer," and that there is so little of these ferments found in the starch cells that "it is practically negligible." Furthermore, "the aleuron layer has nothing whatever to do with this process," namely, the change of starch into a soluble form for absorption by the embryo, which is identical with what takes place in "malting." Hence the scutellum is the "malting organ," and that barley is best for malting purposes that contains the largest scutellum in the grain.

CHARLES E. BESSEY
THE UNIVERSITY OF NEBRASKA

SPECIAL ARTICLES

SOME GEOLOGICAL PROBLEMS

AMONG the larger problems in the geology of eastern North America which to-day claim attention are: the determination of the eastward and southeastward extension in their metamorphosed condition of the less altered rocks of the Hudson Valley and the satisfactory separation from these of the pre-Cambric; as well as the separation and correlation of the divisions of the latter, if such exist.



J. D. Dana early essayed to show the continuity of the limestones and schists of the New York-Connecticut border with those of Westchester County, New York. F. J. H. Merrill took up the question later and reached practically the same conclusions. The work of Cook in New Jersey had shown how intimately the lower Paleozoics are involved in the Highlands of that state. Many of the facts seemed to point to a oneness in age of much of this limestone, schist and slate with the unaltered rocks to the north and west in the Hudson Valley and on the flanks of the Highlands.

The continuity of these rocks over large areas has been suggested and assumed rather than proved. Notwithstanding this they form a part of the same general problem, and any assumption regarding the age of one portion of this belt makes more imperative the need of better establishing the principles that will apply to the region as a whole. Any suggestion of incorrectness in age of any part raises the whole question to the fore.

Great uncertainty prevails in the minds of the Connecticut geologists as to the age of the greatly injected, disturbed and altered schists and limestones in the western part of that state. Manifestly any reasonable interrogation regarding the generally assumed age of the limestones and schists of southeastern New York is of great interest. The recent conservative suggestion of Berkey that the Inwood limestone and Manhattan schist are of pre-Cambric age is a case in point.

The work of Hitchcock and Emerson in Massachusetts, that of Percival, Dana and the Connecticut Survey in Connecticut, and that of Mather, Dana, Merrill and Berkey in New York has done much to unravel the complicated geology of this region; but much confessedly awaits solution. The problem is to a great extent a structural one and is complicated through metamorphism by igneous intrusion.

Limestones are known in the pre-Cambric rocks of Massachusetts, southeastern New York and New Jersey in the proximity of limestones of younger age. The uncertainty is not at this point, but as to which is which. The work of Cook, Britton, Nason and Bayley does not leave us clear as to what is assignable to the pre-Cambric and what to the Paleozoic in the Highlands of New Jersey. The New York geologists are working at this problem, and the New England geologists will doubtless take the subject up again in the near future.

Much doubtless depends upon the success we may attain in correlating areas with one another as well as in establishing principles that will fit them all, and to what extent such a thesis as may be drawn up can be supported by actual evidence, or reasonable inference, or both. With these general principles our interpretations of specific phenomena must fit if the principles are to stand.

The Geology of Dutchess County, New York.[1]

The study of these problems reasonably begins with the examination of the least altered strata of the Hudson Valley. These strata, showing continuously increasing metamorphism as they are traced eastward, are well displayed in Dutchess County. Field work in this county reveals that the metamorphism approaches the character of a function of the distance of the strata from the Hudson River. The increment by which the metamorphism approaches a given degree varies in value, but apparently always is greater per unit distance as one approaches the southern part of the county. The fact that the pre-Cambric rocks cut through the southeastern and southern portion of the county indicates that the degree of metamorphism may, in a measure, be directly connected with the proximity of the Highland mass.

The accompanying generalized sketch map is not intended to show the details of the areal geology of southeastern New York but rather to show pictorially the character of the general problem. It is based upon personal work in Dutchess County, particularly in the Poughkeepsie quadrangle, and upon the maps of Dana, Smock, Merrill and Berkey.

The north and south continuity of the western limestone belt (Barnegate or Wappinger) of Dutchess County was shown by W. B. Dwight. The identity of the eastern so-called Millerton-Fishkill belt with the Wappinger was proved for its northern or Millerton portion by the same worker. Recent work by the writer in the southern portion of the eastern belt, the Fishkill limestone, shows conclusively by the discoveries of fossils the presence of Georgian and Beekmantown terranes within this formation.

While considerably more metamorphosed than the Wappinger the alteration of the eastern limestone has not obliterated the

[1] Published with the consent of the New York State Geologist.

evidence of its age. The identity of the northern and southern portions of this belt is thus shown, and the eastward metamorphosed extension of the rocks of the Wappinger belt is likewise demonstrated. The intrarelationships of the western Wappinger are in some cases duplicated in part in the eastern belt. With these facts in mind the shading on the map is designed to show the gradation in metamorphism to the eastward.

To the east and south on the map are extensive areas of limestone and schist, for the most part left unmarked and unbounded, the satisfactory proof of the age of which awaits demonstration. Smaller patches not represented on the map, more intricately involved and often associated with igneous rocks, are scattered here and there in the Highlands. The great complex extends eastward into Connecticut, and southwestward into New Jersey, and has its representatives to the north in Vermont and Massachusetts. That it is a puzzling area is stating the case mildly. It must be attacked with a mind open for the reception of data bearing on the question of the possible genetic identity of extensive and disconnected masses or for the consideration of features that point the other way. The structure of the region must be unraveled and the earlier relationships of the component rocks restored. Moreover, it may be considdered an open question, if with the changes that the pre-Cambric rocks had early undergone, the later deformations and metamorphic agencies would not have produced a relatively greater alteration in the younger rocks.

It is purposed to discuss more fully certain features of the general problem in a forthcoming report on the geology of the Poughkeepsie quadrangle.

C. E. Gordon

Amherst, Mass.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE SECTION G—BOTANY

Section G of the American Association for the Advancement of Science met during convocation week at Baltimore, the sessions being held at the Eastern High School. The attendance of botanists was unusually large and representative, and so many papers were offered for presentation that it was found necessary to divide into subsections. In Subsection A were presented the papers in morphology, physiology, ecology and taxonomy, while the papers in pathology were presented in Subsection B. Vice-president Richards presided over Subsection A, and Dr. F. L. Stevens, of the North Carolina College of Agriculture and Mechanic Arts, was chosen by the section to preside over Subsection B. As at the Chicago meeting the program of the section interlocked with that of the Botanical Society of America, so that program conflicts were reduced to a minimum. The address of the retiring vice-president, Professor Charles E. Bessey, on "The Phyletic Idea in Taxonomy," has been published in full in Science.

The following officers were chosen:

Vice-president—Professor D. P. Penhallow, McGill University, Montreal, Canada.

Member of the Council—Joseph N. Rose, U. S. National Museum, Washington, D. C.

Member of the Sectional Committee (five years) —Dr. D. T. MacDougal, Carnegie Institution, Tucson, Ariz.

Member of the General Committee—Professor Aven Nelson, University of Wyoming, Laramie, Wyo.

In view of the increasing difficulty of arranging the program in an equitable manner, the sectional committee appointed the retiring vice-president, Professor H. M. Richards, the incoming vice-president, Professor D. P. Penhallow, and the secretary, Dr. Henry C. Cowles, as a special program committee for the Boston meeting. In view of the coming meeting of the British Association at Winnipeg, the choice of a Canadian botanist for the vice-presidency of the section is regarded as most fortunate, and although no specific action was taken by the section at Baltimore, it was the general consensus of opinion that the American botanists should do all in their power to make the sojourn of the British botanists in America pleasant and profitable.

Abstracts of the technical papers presented at Baltimore follow, arranged in the order given in the respective subsections:

SUBSECTION A

Bog Toxins and their Effect upon Soils: Alfred Dachnowski, Ohio State University, Columbus, Ohio.

In a previous communication (*Bot. Gaz.*, 46: 130–143, 1908) attention was called to experi-

mental data showing that the inhibiting factors of bog conditions are in part due to the presence of injurious toxic water-soluble substances, reactions of the plants themselves, that such toxicity can be corrected by various methods, and that the plants grown in solutions thus treated show not only accelerated growth and an increase in transpiration, but also an increase in the green and dry weights of the plants.

Further experiments were undertaken to determine whether the toxins of bog water which are harmful to agricultural plants in water cultures are injurious also to plants growing in soil. A series of soils, ranging from pure quartz, sand and clay to humus were infected by shaking each with bog water, and filtering off the solutions. The results of these experiments indicate: (1) that the bog solutions thus treated become highly beneficial, (2) that soils absorb the toxins present in bog water, (3) that the soils are infected when treated in this manner and cease to yield a normal growth of plants when compared with similar soils serving as controls.

Initiating Licheno-ecologic Studies in the Kentucky Mountains: BRUCE FINK, Miami University, Oxford, O.

The writer has long felt that most of the problems of lichen ecology require an unusually long time for their solution and during the past few months has been able to initiate such studies in two places with a view to continuing the work begun through many years. The work in the Kentucky mountains was done on the forest reserve of Berea College, five miles from Berea, Ky. This locality in the foot-hills of the Cumberland Mountains was selected because the area is to remain undisturbed. Thirty-one areas of varying size and form were marked off, some of them left undisturbed after taking careful notes of the size and condition of development of the lichens within them, others denuded to a considerable depth below the surface of the soil or rock, while on others the plants were only partially destroyed, the object being to watch the rate of growth, invasion, regeneration, etc. The areas were numbered and dated, and were selected in groups so that the study of ecologic factors to follow with instruments may be facilitated as much as possible.

Descriptions of Species of Opuntia: DAVID GRIFFITHS, U. S. Department of Agriculture, Washington, D. C.

An effort was made in the paper to show the relative value of diagnostic characters in this group of plants, and to show how different conditions radically affect these characters. A scale of points is made out to show a proposed sequence in descriptive literature. Stress was placed upon the necessity of field studies and descriptions drawn therein which shall describe the entire plant instead of a terminal joint or two, as has usually been done.

Physiological Studies on the Hymenophyllaceæ: FORREST SHREVE, Carnegie Desert Laboratory, Tucson, Ariz.

Both physiological and anatomical evidence has been obtained to show that the leaves are the principal water-absorbing surfaces, and that there is very limited conduction of water in the vessels. Most Hymenophyllaceæ are capable of withstanding total submergence in well-aerated water for one month. Fragments of leaves with as few as ten cells are capable of maintaining normal appearance in dilute nutrient solutions for over one month. Most Hymenophyllaceæ are incapable of enduring a continued humidity as low as 60 per cent. Several hairy forms are able to endure low humidities of brief duration, and even occasional insolation. These forms are capable of surviving without liquid water if kept in air of over 90 per cent. humidity, and will continue to grow under these conditions. Isolated leaves show an ability to gain steadily in weight when kept in moist air, whereas controls killed in various reagents lost weights as did also the leaves of other species without hairs.

The Life History of Griffithsia Bornetiana: I. F. LEWIS, Randolph-Macon College, Ashland, Va.

The vegetative structures, tetraspores, antheridia, procarps and cystocarps were described in detail, as well as the germination of the spores and the development of the sporelings. Antheridia, cystocarps and tetraspores occur on separate individuals which are almost identical in vegetative structure. The size, shape and arrangement of the cells are the same in the different forms, as are also the size of the nuclei and the number of nuclei in each cell. In mitosis, however, the nuclei of the sexual plants show seven chromosomes, and the nuclei of the tetrasporic plants about twice that number. The reduction of the number of chromosomes takes place in the two divisions in the tetraspore mother cell. The double number is restored by the union of the gametes. The conclusion is drawn that the carpospores, on germination, give rise to tetrasporic plants and the tetraspores to sexual plants. In the alternation of generations thus arising, the sexual plants are to be considered as forming the "x-genera-

tion," while the "2x-generation" comprises the sporogenous cells of the cystocarp and the entire tetrasporic plant. It seems hardly likely, however, that the tetrasporic plants are analogous, save in the number of chromosomes, to the sporophyte of the archegoniates.

Vegetative Reproduction by Induced Root-regeneration in the Guayule: FRANCIS E. LLOYD, Alabama Polytechnic Institute, Auburn, Ala.

Parthenium argentatum (the Mexican guayule) and *P. incanum* (the Mexican mariola) are two woody perennials belonging to the Compositæ and are found in the northern part of the central plateau of Mexico. A comparison of these two species discloses certain differences in the methods of vegetative reproduction which have already been described by the writer. These differences appear to be quite constant in nature. It is, however, possible by experimental methods to force the guayule (*Parthenium argentatum*) to adopt the method of vegetative reproduction which is normally followed by the mariola (*Parthenium incanum*). The paper, of which this is an abstract, describes the experimental conditions and the results obtained.

The Morphology of the Peridial Cells in the Roesteliæ: FRANK D. KERN, Purdue University, Lafayette, Ind.

The value of the sculpturing on the peridial cells as a specific character in defining the species of *Roestelia* has already been ably pointed out by Dr. Ed. Fischer and a number of the American forms have been figured and described by him. Aside from the surface markings there are a number of other features about the peridial cells which are worthy of consideration. It is for the purpose of setting forth the microscopical structure with some detail that this paper is presented. The part played by the peridial cell in making the different appearance between the forms of *Roestelia* and *Æcidium* is discussed. The chief attention, however, is given to the various types of cells and to an explanation of the terms used in describing them. Concrete examples, including many little-known species in addition to the more common ones, are given, together with a number of illustrations.

The Effect of Certain Salts upon Transpiration and Growth in Wheat: HOWARD SPRAGUE REED, Virginia Polytechnic Institute, Blacksburg, Va.

An investigation has been made of the effect of some chemical compounds upon the amount of transpiration per unit of growth in wheat plants. The results are expressed in terms of the units of water transpired per unit of increase in plant substance and by curves which show graphically the increments in transpiration and growth in comparison with control cultures. The data were obtained from several thousand wheat cultures grown in a variety of soils in paraffined wire pots, or in water cultures. Salts of sodium and potassium decrease the amount of water transpired per unit of growth, while salts of calcium and some other substances exert the opposite effect. Increasing the concentration of a salt usually exerts a different effect upon the curves of transpiration and of growth.

The Peg of the Cucurbits: WILLIAM CROCKER, University of Chicago, Chicago, Ill., and LEE I. KNIGHT, University of Illinois, Urbana, Ill.

The peg of the cucurbits is a parenchymatous outgrowth between the root and the stem which aids in the removal of the coat during germination. In the Hubbard squash and some other forms all seedlings produce ring-like pegs approximately equal on all sides (or at least on the two broader faces) if arching and contact are avoided. Under similar conditions in the Big Tom pumpkin and a number of other cucurbits a considerable per cent. of pegless seedlings appear. The functioning of this organ is possible only by its development on the concave side of the arch. The one-sided development is determined by the arching (including perhaps the growth strains preceding the actual arching) of the hypocotyl. Two stimuli aid in the production of the arch-contact of the coats and gravity. The contact of the coats is by far the more effective, for it will induce very sharp arching even against gravity. Gravity, independent of contact, gives strong enough arching to produce only one-sided pegs in all seedlings when the seeds are deviated 170° from the (point downward) vertical position. There is no evidence, contrary to the conclusion of Darwin, Noll and others, that gravity directly stimulates the lateral placement of this organ.

The Effect of Illuminating Gas and its Constituents on Carnations: LEE I. KNIGHT, University of Illinois, Urbana, Ill., and WILLIAM CROCKER, University of Chicago, Chicago, Ill.

The flowers of the carnation are extremely sensitive to traces of illuminating gas in the air, while the vegetation is comparatively resistant. In the Boston Market and pink Lawson varieties three days' exposure to 1 part in 40,000 kills the young buds and prevents the opening of those already showing the petals. The buds of medium age are considerably more resistant. In the same

varieties 1 part in 80,000 causes the closing of the open flowers upon twelve hours' exposure. This injury takes place directly on the bud or flower exposed and not indirectly through absorption by the roots. No chemical test is delicate enough to detect the least trace of illuminating gas in the air. Ethylene is even more fatal to the flowers of the carnation. Three days' exposure to 1 part in 1,000,000 prevents the opening of buds just showing the petals. Twelve hours' exposure to 1 part in 2,000,000 causes the closing of flowers already open. There is much evidence that indicates that the toxic limit of illuminating gas upon these flowers is determined by the ethylene it contains.

Types of Cactus Genera, 1753–1904: J. N. Rose, Smithsonian Institution, Washington, D. C.

Linnæus in 1753 referred all the cacti known at that time to one genus, which he called *Cactus*. Otto Kuntze in 1904, one hundred and fifty years afterwards, recognized but three genera; two of these, *Pterocactus* and *Pereskia*, are small or contain less than a dozen species, and hence the great mass of cacti are to-day to be found in the genus *Cactus* as understood by Linnæus. This might indicate that Linnæus's conclusions were good, but, as we all know, Otto Kuntze was a poor botanist, although he was a great bibliographer and doubtless did more than any one in modern time to stimulate botanical bibliography. Since Linnæus's time 58 genera have been proposed.

What are the types of these genera? Naturalists are now all agreed that the type of a genus must be one of the original species in it. At the present time, however, we have two genera of cacti which do not contain any of the original species and of course are used in an entirely different sense from that which was first intended. These genera are *Pilocereus* and *Epiphyllum*.

Botanists are now pretty well agreed that we ought not to use a homonym of an older genus, and yet we have at the present time in cacti two names which come under this class, viz., (1) *Harriota* DC., 18—, while there is *Harriota* Adans, 1762, also a cactus; (2) *Mamillaria* Haw, 1812, while there is *Mamillaria* Stackh, 1809, a genus of algæ.

Botanists are now pretty well agreed throughout the world that our nomenclature should begin with 1753 and that older names shall not displace Linnæan and post-Linnæan names, but at the present time we have in cacti one pre-Linnæan name which was not taken up until 1827, viz., *Melocactus*.

In the paper as presented there follows an alphabetical list of the genera of cacti, showing the date of publication of the genus, the number of original species and the names of the type species.

Some Variations and Hybrids of Œnothera: R. R. Gates, University of Chicago, Chicago, Ill.

The extreme variant of *O. rubrinervis* which appeared[1] in my cultures is found to breed true to its peculiarity. The presence of red on the hypanthium and in excess on the sepals is correlated with its development in excess on the under surface of the rosette leaves. The same correlation exists in one of the types from *O. nanella* × *O. biennis*. The *O. biennis* in these crosses was from the type growing wild around the New York Botanical Garden. Seven plants germinated from this cross and five of them reached maturity. These were of two sorts, four of which belonged to one type. In this type the rosette leaves were long, rather narrow and pointed, like *O. rubrinervis*. The petioles were red above but more conspicuously so on the under surface. The buds were large like *O. Lamarckiana* and, like the extreme variant of *O. rubrinervis* mentioned, the hypanthium and sepals were red throughout. The excessive development of red pigment from a cross between two types, neither of which shows much red, is an unexpected result several explanations of which are possible. In the second type the buds were small and greenish, showing the *O. biennis* characters.

O. Lamarckiana × *O. biennis*. Nine plants matured, all of one type. The rosettes were very much like *O. nanella* × *O. biennis*, type I, but larger, and the petioles were bright red above but without red on the under surface. The buds showed the *O. biennis* characters, being small, with little red on the sepals and with a short style. The petals varied in size from that of *O. biennis* to intermediate between *O. biennis* and *O. Lamarckiana*.

These crosses were made by Dr. D. T. MacDougal, who presented the seeds to the writer for further cultures.

An interesting "combination type" appeared in a culture of English evening primroses which contain some of the mutants of *O. Lamarckiana* and in addition some new types. The type in question showed the characters of *O. Lamarckiana* in its rosette and stem leaves (absence of red) but the buds were typical *O. rubrinervis*. This combina-

[1] See Science, 27: 209, 1908.

tion type might be called *O. Lamarckiana rubrinervis.*

On the Nature of the Fertile Spike in the Ophioglossaceæ: M. A. CHRYSLER, University of Maine, Orono, Me.

A study of the vascular system of the leaf in the Ophioglossaceæ supports the view that the fertile spike is to be regarded as two fused pinnæ, viz., the two basal ones, which are comparable to the fertile pinnæ of *Osmunda Claytoniana* and *Aneimia* spp. It is found in *Botrychium* that the vascular supply of the fertile spike is double; that the two bundles arise from a curved leaf-trace, at or near its extremities, and higher up approximate but do not fuse. The vascular bundles of the sterile pinnæ arise in a manner identical with that of the vascular bundles of the fertile spike. The mode of origin of the bundles of the fertile spike in each species of *Botrychium* examined may be paralleled by that seen in various genera of ferns, especially *Osmunda.* The genus *Ophioglossum* may be derived from the simpler species of *Botrychium,* while *Helminthostachys* shows certain complications. These facts point to the conclusion that the Ophioglossaceæ are to be regarded as a specialized family of ferns, rather than as a primitive order of pteridophytes.

Origin of Heterospory in Marsilea: C. H. SHATTUCK, Clemson College, S. C.

It is possible by means of a spray of cold water to kill the megaspores, which occur only in the oldest sporangia and then, putting the plant under good conditions, to mature sporocarps without megaspores. The greatest variation occurs when the megaspores and oldest microspores are blasted. Enlargement does not appear among the microspores when less than half the spores abort, and the surviving spores are larger the greater the amount of abortion. The mother cells may be checked in their development till the tapetal nuclei completely invest them. A perinium will then form around the four nuclei, sometimes enclosing them during the first and second mitoses. In such cases the sporangium invariably contains sixteen large bodies, each containing four nuclei. At other times when growth is less checked, the spores are more or less completely free and show great variation in size and shape.

The contest for supremacy among the young megaspores is very evident, many of them assuming considerable proportions, but one, centrally located, invariably secures the ascendancy. Sometimes the contest is very close between two or more members of the same tetrad. Very often the surviving member will carry attached to its papilla the aborted members even to germination.

The enlarged microspores vary in size from eight to sixteen times that of the normal ones, the nucleus shifting from a central (normal) to an apical position as in the megaspores. As vacuolation is more extensive the shape of the nucleus also varies from the normal spherical form to the oval, and finally, in the largest to the meniscus shape in the megaspore.

In extreme cases of abortion in the microsporangia only one spore survives which is about sixteen times as large as the normal microspore. The aborted tetrads remain as in the megasporangium, but better developed, thus showing a sharper contest for supremacy.

In plants kept from fruiting till September 1, many microsporangia (by position) developed megaspores and a few megasporangia developed microspores. In such cases the megaspores were intermediate in size and were also more nearly the spherical shape of the microspores. A few cases were noted in which the megaspores did not develop a perinium but enlarged considerably and became gorged with starch. *Marsilea* may be made to repeat, under culture, all the phases in the development of heterospory reported by Williamson and Scott for both *Calamostachys Benneyana* and *C. Cosheana.*

Movements and Reactions of Fern Spermatozoids: W. D. HOYT, Johns Hopkins University, Baltimore, Md.

The movements of the spermatozoids of ferns are complex and varied and depend on the conditions in which they are placed. When the conditions are unfavorable, they frequently reverse their direction of rotation, and they swing their anterior ends through a larger spiral and change their direction of movement more often than they do when in favorable conditions. The result of this is favorable to the organism in that they come in contact with a larger amount of the medium and so stand a better chance of reaching favorable conditions if these exist anywhere within the medium.

Different spermatozoids may react differently to the same stimulus at the same time, and the same spermatozoid may react differently to the same stimulus at different times. In some cases these differences in behavior can be ascribed to differences in physiological condition induced by different past experiences.

The cases where the movements have been sufficiently slow for exact analysis indicate that ori-

entation is attained by a series of random movements continued until a position favorable to the organism is reached, and not by a direct modification of the motor mechanism due to the local action of different concentrations of the medium on different portions of the body. This conclusion seems reasonably certain for negative reactions and probably for positive ones. The results obtained so far indicate that the movements and reactions of fern spermatozoids are of the same nature as those described for protozoa.

Some Aspects of the Mycorhiza Problem: BENJAMIN C. GRUENBERG, DeWitt Clinton High School, New York, N. Y.

Mycorhiza is found on the roots and underground stems in many families of plants. The identity of the fungus in the symbiosis has been determined in but few cases, and in these not always with certainty.

Many theories as to the relationship between fungus and phanerogam have been offered, but none fits all the facts. It is, however, not to be expected that the mycorhiza has the same significance in all cases: in the different forms the relationship may be of different types, as nitrification, humus disintegration, water absorbing or storing, etc.

To the mycorhizas occurring in plants free from chlorophyll, there has been ascribed the function of obtaining organic nutrients directly from the humus. In several species of *Corallorhiza* examined there are present considerable quantities of starch, notwithstanding the entire absence of chlorophyll from the plants. The constituents of the humus that may yield carbohydrates, and the mechanism for the conversion of these materials into starch remain to be determined.

The solution of certain practical problems, as some in forestry, the transplanting of certain trees, tuberization, nitrification of the soil, etc., may have to wait upon the solution of some of the problems presented by the mycorhiza.

The Morphology of Salvinia (preliminary): WANDA M. PFEIFFER, University of Chicago, Chicago, Ill.

The early stages in the development of sporocarps are as described in Juranyi's "Ueber die Entwickelung der Sporangien und Sporen von *Salvinia natans*" (1873). In the young condition megasporocarps can be distinguished from microsporocarps only by the relatively smaller number of sporangia which they contain.

Later stages in the development of sporangia are very different from Juranyi's figures, since the tapetum was never observed to become two-layered, although the tapetal cells were often multinucleate, and since in no case were there more than eight spore mother cells found in either megasporangium or microsporangium.

The behavior of abortive megaspores was as described by Heinricher, in so far as the position taken by such spores is concerned. The activity of these spores in the formation of the perineum, however, is extremely doubtful since this seems to be entirely built up by the activity of the large, deeply staining tapetal cells.

The relationship of *Azolla* and *Salvinia* is still an open question.

A Preliminary Account of Dioon spinulosum: CHARLES J. CHAMBERLAIN, University of Chicago, Chicago, Ill.[1]

Dioon spinulosum is a Mexican plant and has been known only from the leaves and some small trunks. The plant was found in abundance at Tierra Blanca and at Tuxtepec in March, 1908. The trunk is often six meters in height and occasionally reaches a height of 16 meters. The ovulate cones are very large, elongated ovoid, about 70 centimeters in length and about 30 centimeters in diameter. They often weigh 14 kilos. The sporophylls are comparatively much shorter than in *D. edule* and the seed much larger. The staminate cone is ovoid and measures about 21×10 centimeters. Material is being secured for an extended study.

Demonstration of Seedlings of Selaginella sempervirens: FRANCIS E. LLOYD, Alabama Polytechnic Institute, Auburn, Ala.

A Statistical Criterion for Species and Genera among the Bacteria: C. E. A. WINSLOW, Massachusetts Institute of Technology, Boston, Mass.

The existence of an almost infinite number of minute varieties has so far almost nullified any attempt at a natural classification of the bacteria. The vast numbers of generations which succeed each other in a short space of time, the absence of the swamping effect of amphimixis and the direct effect of the environment all help to make boundaries indistinct among these simple forms. The attempt has been made by the author and his colleagues to attack the problem by the statistical method, and the genera and species of the Coccaceæ have been mapped out in the following way: A number of characters (mostly biochemical, for it is precisely along physiological lines that the bacteria have differentiated, as the higher forms

[1] Investigation prosecuted with the aid of a grant from the Botanical Society of America.

have varied along morphological ones) were measured in a series of 500 cultures by quantitative methods. The results when plotted and compared showed that, on the average, certain properties were notably correlated with each other, and with particular habitats. A parasitic and a saprophytic subfamily were clearly distinguished and within each subfamily several genera were established based on the general correlation of several independent properties. Within the genera each distinct modal point for a particular character was given specific rank. A species is therefore one of the centers about which the numerous existing varieties are grouped; and according to this method a species can be defined, not by the description of an individual, but only by the statistical study of a considerable series.

Effect of Age on the Venation of Leaves: H. M. BENEDICT, University of Cincinnati, Ohio.

The size of the small areas into which the leaves of dicotyls are divided by veinlets is affected by the age of the plant which bears the leaves. The younger the plant, the larger are these "vein islets."

That the size of these areas is not merely a measure of the available nutrition is shown by the fact that leaves from water-shoots which are usually of larger size than normal show smaller areas than smaller leaves from younger plants. Young and old plants growing under the same conditions of environment show the characteristic difference in venation.

As an example of the relation between age and size of areas, some data from a study of *Vitis vulpina* L. may be given. Ten mature leaves from different parts of each vine were taken; pieces 4 by 10 mm. were cut from the same part of each. These were arranged in series and photographed by transmitted light and the number and size of the areas calculated. Since the material was collected where it was impossible to cut down the vines the relative ages of the plants were judged by the diameters of the stems. Care was taken to select vines growing under the same conditions.

Vitis vulpina L.

Diameter of Vine	Average Area of Vein Islets in sq. mm.		Average Area for Plant
	Smallest	Largest	
[illegible] inch	.49	.51	.50
[illegible]	.39	.41	.40
[illegible]	.36	.39	.37
8	.25	.29	.27
6	.12	.16	.14

Observations were made on *Ulmus americana, Castanea dentata, Quercus alba, Q. rubra, Tilia americana, Acer saccharinum, Fraxinus americana* and *Vitis bicolor.*

The Perennation of Cuscuta Epithymum Murr: F. C. STEWART and G. T. FRENCH, New York Agricultural Experiment Station, Geneva, N. Y.

Although Kühn proved clover dodder to be perennial, by observations made in Germany forty years ago, the belief is still current that the species of *Cuscuta* are all annuals. With the exception of a brief note by the senior writer there is no record of any dodder in the United States surviving the winter in the thread form. Yet our observations indicate that *Cuscuta Epithymunt* is frequently perennial. During the past three years this species has lived over winter in New York alfalfa fields, hibernating on the crowns of alfalfa, red clover and certain weeds. This is not accidental or occasional, but of common occurrence. In the writer's opinion it is the chief method by which dodder is carried over from one year to the next in New York alfalfa fields.

The First Generation Offspring of Œnothera lata ♀ × *O. gigas* ♂: ANNE M. LUTZ, Carnegie Station for Experimental Evolution, Cold Spring Harbor, N. Y.

(No abstract is published, because the full paper has appeared in SCIENCE.)

The Plant Formations in Eastern Colorado, and What They Indicate: H. L. SHANTZ, U. S. Department of Agriculture, Washington, D. C.

Three chief plant formations are recognized. They are discussed with respect to general appearance, types of root systems, the water relation of the soil, the influence of breaking the native sod, and the changes which bring about secondary and primary succession.

Notes on the Anatomy of Juncus (preliminary): AMON B. PLOWMAN, Beaver, Pa.

In their minute anatomy the Juncaceæ are strikingly similar to the more aerenchymatous representatives of the Cyperaceæ, such as *Dulichium, Eleocharis* and the limicolous species of *Scirpus.* The central cylinder of the rhizome shows typical amphivasal fibrovascular bundles, which are more numerous and more highly developed in those species of which the rhizomes are short and compact. In the aerial stems showing nodes, the nodal complex is similar to that in *Dulichium.* The reproductive axis contains only simple collateral bundles, arranged in the typical dicotyledonous order.

Are Alpine Plants exposed to Increased Evaporation? CHARLES H. SHAW, Ambler, Pa.

Schimper, Flahault, Schroeter and others lay considerable emphasis on the fact that alpine plants are exposed to more rapid evaporation. Their statements appear to rest on the fact that air movement increases and pressure decreases with altitude, and upon instances of apparent rapid drying, and upon the xerophilous character of many alpine plants.

During the summer of 1908 two series of porous cup atmometers were set up in the Selkirks at altitudes ranging from 800 to 2,788 meters. The stations from 800 to 1,700 meters (first series) were on the same hillside, had the same exposure, and were separated by a total horizontal distance of less than one kilometer. Those from 1,800 to 2,788 meters (second series) were located as far as possible with similar exposure on Mt. Grizzly, and included a horizontal distance of about one and a half kilometers.

Two stations were chosen at each altitude, since a substantial agreement would afford a test of the reliability of the scheme. The instruments of the first series were in continuous operation twelve weeks and those of the second series, for shorter periods. The weather was unusually favorable, there being little rain, clouds or frost during a term of seven weeks. Weekly readings were taken. In most cases the instruments of the several pairs gave approximately the same result.

The maximum in every case was found at the second station, at 1,100 meters altitude. At increasing altitudes, there was a gradual and irregular diminution.

The results of the first series appear to be unquestionable, as also a certain portion of the second series. Taken together they seem to exclude, so far as these mountains are concerned, the idea that evaporation increases with altitude.

Possibly the standard writers may have overlooked the part played by temperature, which is a factor in the evaporation rate, and might more than counterbalance the results of the other two factors.

The above data represent only weekly totals. The possibility of excessive evaporation at high altitudes during certain portions of the day remains to be studied.

Mitosis in Œdogonium: A. H. TUTTLE, University of Virginia, Charlottesville, Va.

A brief review was given of the work of previous observers, and a statement of facts that appear to have been overlooked by them, or whose significance has not been noted.

Attention was particularly directed to the change in size and the marked change in form of the dividing nucleus; and, in addition, to the persistence of a distinct nuclear contour until a very late stage in the anaphase, also to noteworthy features in the mode of formation of the chromosomes, and in their behavior before, during and after splitting. Facts of importance regarding the formation and persistence of the achromatic figure were also presented, with others pertaining to the behavior of the daughter nuclei.

Preliminary Notice of Physiological Studies on Papaver somniferum: R. H. TRUE and W. W. STOCKBERGER, U. S. Department of Agriculture, Washington, D. C.

This paper discusses some studies made on the opium poppy, showing the distribution of oxidizing enzyms in the plant, the distribution of morphin and the relation of morphin production to oxygen.

The following papers were read by title:

Orientation of the Cotyledon of Wheat and Corn Seedlings Stimulated by Light: S. O. MAST, Woman's College, Baltimore, Md.

Some Fundamental Errors in Botanical Teaching: E. C. JEFFREY, Harvard University, Cambridge, Mass.

Methods of Demonstrating the Oxidizing Power of Roots: HOWARD S. REED, Virginia Polytechnic Institute, Blacksburg, Va.

The Collection and Storage of Tree Seed: HUGH P. BAKER, Pennsylvania State College, State College, Pa.

Preliminary Report of the Result of Observations on the Relation of Evaporation to the Treelessness of the Prairies: BOHUMIL SHIMEK, University of Iowa, Iowa City, Ia.

A Summer Laboratory for Mountain Botany in Colorado: FRANCIS RAMALEY and W. W. ROBBINS, University of Colorado, Boulder, Colo.

The Morphology and Development of the Cystocarp in Callithamnion Baileyi: R. P. HIBBARD, Mississippi Agricultural Experiment Station, Agricultural College, Miss.

SUBSECTION B

Two North Carolina Plant Diseases: Hypochnose of Apple and Colletotrichose of Fig: F. L. STEVENS and J. G. HALL, North Carolina College of Agriculture and Mechanic Arts, West Raleigh, N. C.

Hypochnose of apple, pear and quince, which is widely distributed throughout the United States,

but of which the causal fungus has not been before recognized except by Noack in Brazil, is described and notes on its geographical distribution given. Colletotrichose of the fig, *Ficus Carica*, is described and its causal fungus, *Colletotrichum Caricæ* n. sp., characterized.

A Bacterial Rot of the Muskmelon: N. J. GIDDINGS, University of Vermont, Burlington, Vt. (Read by L. R. Jones.)

One fourth of the fruit in a field of Montreal muskmelons at St. Albans, Vt., was ruined by soft rot in the autumn of 1907. This has been proved to be due to a new species of *Bacillus* which will be described in detail and named in the next Annual Report of the Vermont Experiment Station. Its characters in brief summary follow: 1–1.7 μ by .6–.9 μ. Actively motile by 4–6 peritrichic flagella. No endospores; not stained by Gram's method.

(Gelatin cultures at 20° C., others at 30° C.)

Nutrient broth: Strong clouding in 24 hours; no pellicle or ring formation; slight sediment. Agar stroke: abundant, slightly spreading, contoured, slimy, glistening, translucent-opalescent, growth, umbilicate in elevation. Agar stab: filiform. Agar plate: colonies round or amœboid. Gelatin stab: infundibuliform liquefaction in two days. Milk: coagulation and some separation in two days; acid production of + 55 in twenty-one days. Fermentation broths: growth in closed arm in saccharose, dextrose, maltose, lactose, mannite, urea, asparagin, not in glycerin. Vegetables rotted: muskmelon, citron, carrot, potato, beet, turnip. Indol production: slight. Nitrate reduction: abundant. Acid production: slight from carbohydrate broths; pronounced from milk. Ammonia production: strong from asparagin. Gas: slight from asparagin; abundant from milk. Over 99 per cent. of gas from milk was CO_2.

The White Pine Blight: PERLEY SPAULDING, U. S. Department of Agriculture, Washington, D. C.

This popular term includes several well-marked and distinct diseases: a leaf blight accompanied by *Septoria parasitica*, two leaf diseases caused by *Lophodermium brachysporum* and *Hypoderma lineare*, a leaf and twig blight caused by winter freezing and a twig blight probably caused by insects.

Some Toxic Properties of Tannic Acid: MEL T. COOK, Agricultural Experiment Station, Newark, Del.

Within recent years a great deal of work has been done in growing fungi on substances containing different chemicals and in studying the responses to the different stimuli. The series of experiments of which this is a part proposes to treat certain fungi with substances which occur in considerable quantities in the host plants. Tannic acid was selected as the first of these substances because it is so widely distributed and occurs in such great abundance, also because of its occurrence in abnormal growths. It is by no means well understood and is probably somewhat different in different families, genera and species. It has been studied by the chemists and pharmacologists but neglected by the botanists. It is frequently referred to as a waste product, although it is sometimes asserted that it may afford a protection against the attacks of insects, fungi, etc. It has been used to some extent as a germicide and fungicide.

This study has been divided into five series of experiments as follows:

First Series.—A study of the histology of pathological tissues; not treated in this paper.

Second Series.—The growing of fungi in pure media and in the same media to which has been added varying percentages of tannic acid. *Heterosporium*, *Ascochyta*, *Macrosporium*, *Phyllosticta* and *Rhizoctonia* are checked by small percentages of tannic acid. *Glœosporium*, *Colletotrichum*, *Cladosporium*, *Fusarium* and *Sphæropsis* were retarded in most cases, but in some instances were stimulated by small percentages of tannic acid. *Alternaria*, *Sclerotinia*, *Neocosmospora* are stimulated by amounts not exceeding two fifths per cent. Those which are most strictly parasitic are more sensitive to tannic acid than those which are facultative saprophytes. A number of saprophytic forms were also used and were found to be stimulated by or at least to tolerate large quantities of tannic acid in most cases; this was especially true of wood fungi.

Third Series.—Consisted of growing fungi surrounded by barriers of tannic acid. Briefly discussed.

Fourth Series.—Consisted in treatment of fungi with varying percentages of tannic acid for varying periods of time and then placing them under favorable conditions for growth. In most cases the fungi were uninjured by this treatment.

Fifth Series.—Consisted in growing fungi through sheets of cork. Most fungi will penetrate cork readily if the tannin has been removed.

The Present Status of Rice Blast: HAVEN METCALF, U. S. Department of Agriculture, Washington, D. C.

The parasitism of a fungus of the genus *Piricularia*, announced before this section in 1906, and since confirmed by Fulton, has been verified by over six hundred inoculations. The parasite is a *vera causa*, although the occurrence of blast is enormously favored by a soil rich in nitrogen. It is doubtful whether a specific designation of the fungus can be made without revising the genus. The speaker's investigations in Italy in 1908 indicated the identity of blast with *brusone*, and tended to confirm the views of Farneti on the etiology of the disease. As *brusone* has already been shown to be identical with the *imochi-byo* of Japan and the *omo-mentek* of Java, the evidence is strong that blast is a world-wide disease which has only recently reached America. In Italy the disease is practically under control by use of resistant varieties of rice. These were imported by the author and will be tested in 1909.

A Few Diseases of Bamboo and Sedge: Flora W. Patterson and Vera K. Charles, U. S. Department of Agriculture, Washington, D. C.

This paper discusses a few diseases occurring upon these hosts, their morphology, systematic position and especially their economic significance in relation to future foreign introductions. It includes pathological and histological notes on species previously known to cause diseases and the description of a new genus.

Specimens of diseased bamboo, and specimens of diseased sedge with water-color illustrations of the latter, accompanied the presentation of the paper.

Pathological Notes Concerning a Few Ornamental Plants: Flora W. Patterson and Vera K. Charles, U. S. Department of Agriculture, Washington, D. C.

This paper discusses the occurrence of a *Botrytis* disease of peony and chrysanthemum, including cultural notes and statements as to preventive treatment.

A new disease on *Cyclamen* caused by *Colletotrichum* is described together with cultural notes on its development.

Necrosis of the Grape: Donald Reddick, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

Necrosis is a very common fungous disease of the cultivated Labrusca varieties of grape in New York state, and it occurs also on the white scuppernong grape in Alabama.

The disease may be recognized as follows: Vines trimmed and tied up which fail to put out shoots; a dwarfing of shoots and leaves and a light setting of fruit; leaves reduced in size, crimped about the margin and chlorotic; the sudden wilting of vines in late summer; the presence of longitudinally ribbed excrescences or tuberculous masses on any part of the stem; small, black, slightly sunken lesions on the green shoots.

This disease is caused by *Fusacoccum viticolum* n. sp. The fungus causes a dry rot in the stem, the effects on other parts, except lesions on the shoots, being purely physiological.

The fungus has been isolated from the interior of many diseased stems, from lesions on green shoots and from spores developed in stromata on the surface of dead parts. Pathogenicity is not yet absolutely demonstrated, but this is the only organism constantly associated with such conditions. The most serious effects of the fungus are found in very young vineyards and it is thought that this is due to the use of diseased cuttings for stock.

Root crowns are often free from disease and this affords a means of control, viz., by renewal with a sprout from the root.

A Blight of Cultivated Ginseng caused by Alternaria Panax n. sp.: H. H. Whetzel, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

The greater part of the million dollars' worth of ginseng now annually exported from the United States is grown under cultivation. Though but very recently brought under domestication, it is known to be subject to a number of diseases.

The most common and destructive disease is the so-called *Alternaria* blight. It is characterized by the appearance of brown cankers on the stems and large watery spots in the leaves which may eventually involve the entire leaf and top. Badly blighted plants appear as if drenched with boiling water.

The pathogenicity of the *Alternaria* constantly occurring in the lesions has been definitely determined by inoculation.

Experiments extending over three years have shown that it may be controlled by the thorough application of Bordeaux mixture.

On a Method of Developing Claviceps purpurea Tul. with Notes on Claviceps rubra n. sp.: H. H. Whetzel and Donald Reddick, New York State College of Agriculture, Cornell University, Ithaca, N. Y.

Early in August, 1907, sclerotia of *Claviceps*

were collected in heads of Volunteer rye, and of roadside timothy in Noble County, Ind. August 20, 1907, sclerotia on *Dactylis glomerata* were collected at Ithaca, N. Y., and, on August 23, on *Festuca elatior*. On the latter date these collections of sclerotia were encased separately in ordinary wire screening and placed on the ground under a grape arbor to mature. April 6, 1908, all were brought to the laboratory and placed on moist sand in a covered stender dish. April 18, 1908, a few sclerotia in all dishes were found with developing stromata. At this time the stromata on timothy were further advanced and were very evidently different. Stromata from ergot on rye had mature perithecia about May 1, while those on *Dactylis* and *Festuca elatior* were mature May 6. May 23 all had fruited and gone.

The *Claviceps* on rye, *Dactylis* and *Festuca* all belong to the same species, at least morphologically, *i. e.*, *C. purpurea* Tul. A few sclerotia on *Phleum* unmistakably developed typical *C. purpurea;* most of them developed a Claviceps with much smaller stromata which are of an entirely different color, have fewer and more prominent perithecia, and these contain smaller spores. It seems to be an undescribed species. Careful search was made in June, 1908, for the sphacelial stage in the type locality but it was not found.

Some Little-known Diseases of Conifers found in Connection with a Disease Survey of our Western Forests: GEORGE GRANT HEDGCOCK, U. S. Department of Agriculture, Washington, D. C.

The disease survey of our western forests which is now being conducted by the Laboratory of Forest Pathology, although it has not passed the preliminary stage, has brought forth some interesting data concerning a number of wood-rotting fungi which may be properly classed as wound parasites. These cause great losses to the country by diminishing to a very considerable extent the available supply of mature timber. They do not occur uniformly in any given forest, but abound in certain favorable environmental conditions.

Echinodontium tinctorium is the cause of a destructive heart rot of living trees belonging to a number of species. It attacks the following species: *Abies nobilis* Lindl., *A. concolor* (Gord.) Parry, *A. grandis* Lindl., *A. lasiocarpa* (Hook) Nutt., *Tsuga heterophylla* (Raf.) Sargent and *Picea Engelmanni* Engelm. In a few localities as high as sixty per cent. of *Abies* and nearly one hundred per cent. of *Tsuga* have been reported diseased by this fungus. The fungus usually enters the heart wood of the trees attacked either through a broken limb, fire scars or other wound. The mycelium evidently secretes a solvent for wood fibers, since they are often entirely dissolved in the later stages of the rot produced by the disease. The sporophores contain a red pigment which is especially characteristic of this species. This is used by the Indians for making paint for facial decorations, etc. The red coloring matter in the pigment is insoluble in the ordinary solvents, with the exception of the alcohols, which apparently dissolve out a yellow color.

Fomes laricis attacks the heart wood of a number of species of conifers. The fungus gains entrance into the heart wood in the same manner as *Echinodontium*. It has been found on the following species: *Pinus ponderosa* Laws., *P. Murrayana* "Oreg. Com.," *P. Lambertiana* Dougl., *Larix occidentalis* Nutt. and *Pseudotsuga taxifolia* (Lam.) Britton. The effect of this fungus on the heart wood of trees is somewhat different from that of *Echinodontium;* it does not so completely dissolve the wood fibers, but apparently carbonizes them, causing the wood to break up into blocks or rectangular pieces. Large sheets of punk or tinder are formed by the mycelium adjacent to sporophores in later stages of the disease. The decayed wood is of a red-brown color, resembling very much that produced by *Fomes pinicola* (Sw.) Gill., which is frequently the cause of a sap-rot of mature conifers, but is rarely found fruiting on living trees. *Fomes laricis* usually forms sporophores on living trees, but may in case of very large trees consume the heart wood for years before it brings forth fruiting bodies. The white chalky sporophores are often of very great size. They have been powdered and used as a medicine in Europe for ages, and owing to the bitter taste of the substance of which they are composed, have been designated as the "quinine fungus."

Several other wood-rotting fungi of lesser importance have been found in various localities, a study of which will be undertaken later. In our disease survey work the investigation of such problems is not confined to the immediate study of the parasite, its effect on the host and remedial and preventative methods. It is our purpose in the future to collect data upon the conditions in the forest which make the trees of certain areas more subject to disease than those of others in the same locality. This involves a study of the physical conditions of those localities where disease is prevalent in order to find out how they

vary from the conditions in adjacent localities where the trees remain healthy.

The Present Treatment of Monotypic Genera of Fungi: C. L. SHEAR, U. S. Department of Agriculture, Washington, D. C.

The following seven monotypic genera of fungi, *Cœlosphæria* Sacc., *Cryptosphæria* Grev., *Cylindrosporium* Grev., *Isothea* Fr., *Næmaspora* Willd., *Septaria* Fr., *Sphæropsis* Lev., selected at random from the Pyrenomycetes and Fungi Imperfecti are cited as examples of the present condition of the nomenclature of the fungi as represented in recent general systematic works such as Saccardo, "Sylloge Fungorum," Engler and Prantl, "Pflanzenfamilien," Rabenhorst's "Cryptogamenflora" and Ellis and Everhart's "North American Pyrenomycetes." The rule adopted by the international zoologists and the American botanists that a monotypic genus must always contain its monotype appears to receive no particular recognition. The original monotypes of the genera mentioned have been transferred to other genera of later date and the original generic names are now applied to other groups of species and frequently attributed to other authors. The desirability of recognizing the fixity of monotypic genera and genera having a species specifically designated as type is suggested as an essential part of the rules to be formulated by the section of the International Botanical Congress which is to consider the nomenclature of cellular cryptogams at its meeting at Brussels in 1910.

A Bacterial Disease of the Peach: JAMES BIRCH ROREB, U. S. Department of Agriculture, Washington, D. C.

For the past three seasons the writer has made observations on a disease of peach leaves, twigs and fruit, evidently caused by a bacterium.

The form on the leaves is the commonest and most widespread. It causes somewhat angular purplish-brown spots one eighth to one fourth inch in diameter, which soon drop out, giving a shot-hole effect. Serious outbreaks of the disease cause a premature defoliation of the trees. This leaf spot was first seen by the writer on peach leaves collected in Georgia in 1903 by Mr. P. J. O'Gara, of the Department of Agriculture. During the same season Clinton observed a disease, evidently the same, in Connecticut and reported in the Report of the Connecticut Agricultural Experiment Station for 1903, Part IV., page 337. In 1906, 1907 and 1908 the writer found the disease to be prevalent throughout the south and middle west.

In August, 1906, pure cultures of an organism were obtained from the leaf spots and in the following spring inoculations made with this organism caused spots in all respects similar to those from which the bacterium was originally obtained. The same organism was again obtained in pure cultures from the spots which were artificially produced.

The disease on the twigs was first observed in 1907 at Siloam Springs, Ark. It kills the bark of young shoots, forming purplish-black, slightly sunken areas one eighth to one fourth inch wide, which may extend for two or three inches along the stem. In 1908 this twig disease was found in an orchard in Bentonville, Ark. Numerous sections through the youngest spots showed the presence of bacteria in large quantities and by the poured plate method cultures of an organism similar to that from which the leaf spots were obtained. No attempt has been made as yet to produce this form of the disease by inoculation.

The disease on the fruit is very characteristic. It was found in two orchards at Bentonville, Ark., during the past season. It causes a very small purplish spot over which the skin soon cracks, in either a straight or an angular way. The spots are usually very numerous (two hundred and fifty have been counted on one side of a peach), and often coalesce so that the cracks become continuous and extend for an inch or more. Sections through the smallest spots showed that bacteria were present in abundance and evidently the cause of the trouble.

Though not entirely proved, it is assumed that the three forms of the disease mentioned above are caused by *Bacterium pruni* Erw. Smith, which causes the bacterial black spot of the plum, for the following reasons: (1) the leaf spot of plums caused by *B. pruni* is very similar in appearance to that of the peach; (2) by inoculation with pure cultures of *B. pruni*, spots may be produced on peach leaves similar in all respects to those occurring naturally; (3) the organism isolated from the peach leaf spot and twig spot have the same cultural characteristics in all the different media in which they have been grown as *B. pruni;* (4) though the organism has not been obtained in pure cultures from the peach fruit spots, the megascopic and microscopic appearance of these spots is identical with the small spots on the plums, especially those which result from late infections.

The Cause of Trembles and Milk Sickness: E. L. MOSELEY, Sandusky High School, Sandusky, O.

Experiments made in 1908 confirm the conclusion reached after experimenting on various animals in 1905, viz., that *Eupatorium ageratoides* is the cause of trembles and milk sickness. A rabbit with four sucking young was fed with this plant, causing trembles in all of them. Two of the young were killed and cooked and fed to a cat, causing trembles. Milk from a cow with whose food *Eupatorium* leaves were mixed caused trembles in cats and rabbits. The milk was found to contain aluminum and an increased quantity of magnesium. The urine of a rabbit fed with the weed contained much aluminum. These substances exist in large quantities in the ash of the plant, the amount of magnesium differing in plants from different sources. Magnesium nitrate mixed with the food of a rabbit produced trembling. The symptoms of trembles observed by those who have lost stock from this cause are the same as result from aluminum and magnesium compounds when they get into the blood.

Peach Yellows Disseminated by Nursery Trees: J. L. PHILLIPS, Blacksburg, Va.

Peach pits and buds are sources of infection. The disease does not usually appear in nursery stock. It appears in orchards in the second and third years. Peach pits should be sold under certificate of inspection.

A New Anthracnose Attacking Certain Cereals and Grasses: THOMAS F. MANNS, Ohio Agricultural Experiment Station, Wooster, O. (Read by A. D. Selby.)

This paper stated briefly the results of culture investigations of a fungus described as *Colletotrichum cereale*, n. sp. This has been found to be present generally over the state of Ohio, attacking the spikes, culms and sheaths of rye, the culms and sheaths of wheat, oats, chess, orchard grass, timothy, red-top and blue-grass. Upon the cereals the attack is timed to the approaching maturity of the plant and produces marked shrivelling of the grain. The behavior of the fungus on different media is stated, and different illustrations are included.

A New Bacterial Disease of the Sugar-beet Leaf: NELLIE A. BROWN, U. S. Department of Agriculture, Washington, D. C.

Last summer a new disease of the sugar beet was observed in the beet fields in Utah and California by Dr. C. O. Townsend, pathologist in charge of sugar-beet investigations, Department of Agriculture, Washington, D. C., who sent material to his laboratory for investigation.

The leaves had dark brown, often black, irregular spots from 3 mm. to 1.5 cm. in diameter. They occurred on the petiole, midrib and larger veins. Occasionally the discoloration extended along a vein some distance and the tissue on either side was brown and dry. An organism was plated out of these spots without difficulty and found to be a schizomycete. Inoculations were made in the greenhouse and in the open field at Garland, Utah. The infection did not fail to take in any case.

So far as the work has been carried, the organism is infectious to the sugar-beet root, leaves of lettuce, sweet pepper, nasturtium, egg-plant and leaves and pod of the bean.

On agar plates the colonies are cream-white by reflected light, bluish in transmitted light, thin circular, rapid-growing, appearing in twenty-four hours. In three days the surrounding agar becomes a yellowish green color.

The organism liquefies gelatin, turns litmus milk-blue, does not grow on Cohn's solution, clouds bouillon in twenty-four hours, and is motile by means of one to three polar flagella. It occurs singly or in chains, the elements being short rods from 2 to 4 μ long and 1 to 1.5 μ wide, when grown in agar two days and stained with Loeffler's stain. It grows best at a temperature of about 28° C. and is not killed when kept at — 2° C. for six days.

From spots produced by inoculation, the organism has been reisolated and the disease reproduced. One hundred per cent. of the inoculations have given positive results. Both young and old tissues are alike susceptible to the disease.

A New Bacterial Disease of Nasturtium: CLARA O. JAMIESON, U. S. Department of Agriculture, Washington, D. C.

In May, 1908, Dr. C. O. Townsend, pathologist in charge of sugar-beet investigations, Department of Agriculture, Washington, D. C., received a few diseased nasturtium leaves from Richmond, Va. The wilted and partly discolored leaves showed water-soaked-looking spots from 3 to 5 mm. in diameter. Investigation proved the disease to be due to a bacterial organism belonging to the genus *Bacterium*. Inoculations of healthy leaves produce small dark, watery areas, and the tissue within them discolors, shrivels and often breaks.

The bacterium is a short rod from 2 to 4 μ in length, occurring singly or in chains. The polar flagella vary from 1 to 3 μ. The organism has moderate vitality on culture media, clouds bouillon in 24 hours and grows rapidly on agar, appearing on poured plates as small round, bluish-

white colonies. The bacterium liquefies gelatin, gives an alkaline reaction in litmus milk and produces no gas in fermentation tubes containing peptone-water and 1 per cent. solutions of diffused sugars.

The organism is not killed when kept at a temperature of $-2°$ C. for six days. It grows best on agar at about 25° C., and its thermal death point, found by exposing ten minutes in nutrient solution, is between 49° C. and 50° C.

The bacterium is pathogenic on the leaves of sweet pea, lettuce, pepper and sugar-beet and on the leaves and pods of the bean.

Decay of Potatoes Due to Rhizopus nigricans: W. A. Orton, U. S. Department of Agriculture, Washington, D. C.

A study has been made by the Bureau of Plant Industry of potato diseases in the peat lands of San Joaquin County, Cal.

The most prevalent form of decay is a rapid soft rot, caused by *Rhizopus nigricans* Ehrdt. This is characterized by a dull-brown discoloration of the outer skin and a slight brown discoloration of the flesh, which when cut open soon oxidizes to a reddish-brown. The tissue becomes soft, owing to a solution of the cell walls, and on squeezing there is liberated an abundance of clear brown liquid. This feature has given the disease the local name of "leak" or "melters." There is no bad odor until the invasion of secondary saprophytes.

The large, hyaline, non-septate hyphæ of the fungus are abundant in the tissue. No other organism occurs in the typical "leak." Pure cultures are readily obtained, and a similar decay may be produced by inoculation of sterile raw potatoes under suitable conditions of temperature and moisture. Differences were observed in the rate of decay produced by *Rhizopus* from different sources, that from potatoes producing decay in potatoes sooner than a culture from bread.

Rhizopus nigricans is a wound parasite, capable of affecting potatoes only through abrasions of the epidermis. It appears to spread most rapidly during the "sweat" following the digging of early potatoes in warm weather and gives no trouble after frost comes.

The same fungus causes a destructive rot of sweet potatoes, and will quickly liquefy apples and pears. *Rhizopus necans* Mass., a related species, causes a decay of lily bulbs in Japan.

Some Devices to Facilitate Work in Plant Pathology: E. Mead Wilcox, University of Nebraska, Lincoln, Nebraska.

The method recommended in this paper is, in brief, to arrange all of the material used in pathology work according to one method. It has been found very useful to arrange lantern slides, negatives, index cards, herbarium material and publications alphabetically by the scientific name of the diseased plant, with sub-headings for the several diseases. The herbarium specimens are kept in the ordinary envelopes, which are attached to cards arranged behind guide cards in a vertical file case. The color of the card indicates the part of the plant which is diseased. For example, on the green card would appear specimens of leaf disease, etc. The publications bearing on plant pathology are gathered together and bound by subjects; this necessitates in many cases the partial destruction of a larger publication containing articles on several subjects, but the result is a compact mass of literature on one subject.

The following papers were read by title:

The Spraying of Cedars for "Cedar Apples": F. D. Heald, University of Texas, Austin, Tex.

A Fusarium Disease of the Pansy: Frederick A. Wolf, University of Texas, Austin, Tex.

Studies in Sclerotinia; Sclerotinia fructigena (Pers.) Schröt.: J. M. Reade, University of Georgia, Athens, Ga.

Experiments in the Production of an Anthracnose Resistant Clover: S. M. Bain and S. H. Essary, University of Tennessee, Knoxville, Tenn.

Two Interesting Smuts: L. H. Pammel, Iowa Agricultural College, Ames, Ia.

Henry C. Cowles,

SOCIETIES AND ACADEMIES

THE NEW YORK ACADEMY OF SCIENCES
SECTION OF BIOLOGY

A regular meeting of the section was held at the American Museum of Natural History, on March 8, 1909. In the absence of the chairman, Professor Bashford Dean presided for the evening. The following papers were read:

Genetic Relations of the Insectivora to other Orders of Mammals: Mr. W. K. Gregory.

The Harpswell Biological Laboratory: Mr. Max Morse.

The speaker showed a series of slides illustrating the Harpswell region and environs. The laboratory was founded by Dr. J. S. Kingsley in 1898 in the little fishing village of South Harpswell, Maine, eighteen miles from Portland. The immediate region is rich in interesting forms of

animal and plant life which are peculiarly adapted to the use of the investigator. The laboratory offers no courses of instruction, being solely for the use of investigators. The old Tide-mill collecting ground and samples of some of the more important animals and plants to be found there, were illustrated. The geology of the Harpswell region has not been worked up and this presents interesting questions, especially in glacial geology. The speaker pointed out the advantages offered by the laboratory over those of our other marine stations.

Early Developmental Stages in Recent and Fossil Corals: Professor A. W. GRABAU.

Paleozoic corals show in their septal development a fundamental tetrameral plan. This is persistent in the earliest known forms, but becomes masked in later species by the secondary assumption of radiality. The development of mesenteries of modern Hexacoralla shows a similar order of appearance. Pairs of mesenteries develop in succession in bilateral disposition. From the position of the muscle strands they are either *dorsads* (musculature turned dorsal-ward) or *ventrads*. The first and second pairs are ventrads. The third (ventral directive) is a pair of dorsads, the fourth (dorsal directive) a pair of ventrads. The fifth and sixth pairs are dorsads forming with the first and second pairs four false pairs of "braces." After that the mesenteries appear in compound pairs, a pair of dorsads and one of ventrads appearing simultaneously. Thus in the corresponding inter-mesenterial spaces a *brace* of new mesenteries appears, the order being comparable even in detail to the order of appearance of the septa in the Paleozoic Tetracoralla.

A REGULAR meeting of the section was held at the American Museum of Natural History, on April 12, 1909. In the absence of Mr. Frank M. Chapman, chairman of the section, Professor Chas. L. Bristol presided. The following papers were read:

Final Report on the Exploration of the Fayûm in 1907: Professor HENRY F. OSBORN.

In the absence of Professor Osborn, this report was given by Mr. Walter Granger, of the American Museum of Natural History. The speaker stated that the collection obtained by the expedition has been prepared and proves to contain representatives of nearly all of the mammalian forms known from this region, together with several new genera and many species. Among the new forms are rodents, recorded for the first time from these beds, and two peculiar small forms of uncertain ordinal positions. The collection contains many fine specimens of described species which add much to the previous knowledge of these interesting mammals. Doubt was expressed as to the relationships of the genus *Megalohyrax* to the Hyracoidea and *Mœritherium* to the Proboscidia. The speaker stated that the collection of 1907 is being increased through the efforts of a representative maintained in the Fayûm.

By chart and slides the geology of the region was illustrated, also the important topographic features and the method employed in prospecting and collecting the fossils.

Studies on Tissue Growth: Dr. CHAS. R. STOCKARD.

The Partulas of the Society Islands and the Problem of Isolation: Professor HENRY E. CRAMPTON.

The speaker presented some of the general results obtained during investigations in 1906, 1907 and 1908, dealing with the variations and distribution of terrestrial snails of the genus *Partula*, inhabiting the Society Islands. The geographical and physiographical conditions were described. The islands of this group are volcanic peaks of a partially submerged range; these peaks occur sometimes in contact, as in the double island of Tahiti, while others have greater or lesser distances between them. It is, therefore, possible to correlate the specific differences between the snails of different cones with the geographical proximity of the cones. As each island peak is furrowed more or less regularly by valleys and as the snails occur only in the moist bottomlands of these valleys, it is possible to correlate the degree of resemblance between the species of neighboring valleys with the degree of geographical isolation. In brief, such correlations are extraordinarily close, as in the case of the classic Achatinellidæ of the Hawaiian Islands described by Gulick.

The varieties of snails growing in different valleys of one and the same island, or in different islands of the group, can not be regarded as produced in different environmental circumstances. Several illustrations were given which established this conclusion. The phenomena of mutation were observed in several islands. Finally the rôle of natural selection was determined to be a much restricted one in the case of these snails.

L. HUSSAKOF,
Secretary

AMERICAN MUSEUM OF
NATURAL HISTORY

THE ELISHA MITCHELL SCIENTIFIC SOCIETY OF THE UNIVERSITY OF NORTH CAROLINA

THE 183d meeting of the society was held in Chemistry Hall, Tuesday, April 1909, at 7:30 P.M. The following papers were presented:

"The Linear Classification of the Cubic Surface," by Professor Archibald Henderson.

"Trichlorethylidenediphenamine Compounds," by Professor Alvin S. Wheeler.

ALVIN S. WHEELER,
Recording Secretary

THE AMERICAN CHEMICAL SOCIETY. NORTHEASTERN SECTION

THE ninety-second regular meeting of the section was held at the Twentieth Century Club, Boston, on April 8. Professor W. D. Bancroft, of Cornell University, addressed the section upon "The Reversal of the Photographic Image." The speaker advanced a new theory to account for the appearance of a positive and of a second negative upon the development of over-exposed photographic plates, and showed how, by the aid of this theory, many obscure phenomena connected with reversal are capable of a simple explanation. Dr. H. W. Morse, of Harvard University, addressed the section upon "Some New Methods of Nitric Acid Manufacture." After describing the method of synthesis used in Norway, the speaker discussed in detail the "Ostwald Process" for the oxidation of ammonia to nitric acid by the air with platinum foil as the catalyzer.

KENNETH L. MARK,
Secretary

THE SCIENTIFIC SOCIETY OF NORTH DAKOTA

IN October of last year a general scientific society was organized with headquarters at the North Dakota Agricultural College and Experiment Station. Administration officers are as follows:

President—J. H. Shepperd, dean of agriculture.

First Vice-president—Linwood A. Brown, professor of pharmacy.

Second Vice-president—H. L. Bolley, professor of biology.

Secretary—Roe E. Remington, instructor in food chemistry.

The society meets fortnightly, and the following papers have been presented:

October 7—"Fixation of Nitrogen," Roe E. Remington.

October 21—"Weed Eradication by Means of Chemical Sprays," H. L. Bolley.

November 4—"The Geology of the Stump Lake Region," D. E. Willard.

November 18—"The Relation of some Recently Formulated Biological Principles to Plant Breeding," O. O. Churchill.

December 2—"Some Engineering Problems connected with Water Filtration," R. H. Slocum.

December 16—"The Sanitary and Bacteriological Purification of Water," T. D. Beckwith.

January 13—"Some New Productions in Plant Life," J. H. Shepperd.

January 27—"Denatured Alcohol, Manufacture and Uses," Grant J. Morton.

February 10—"Darwin and after Darwin," C. B. Waldron.

February 24—"Birds of North Dakota," W. B. Bell.

March 10—"Studies on Soil Toxins," J. W. Ince.

THE ANTHROPOLOGICAL SOCIETY OF WASHINGTON

A SPECIAL meeting of the society was held on Tuesday, April 27, 1909, President Fewkes in the chair. The program consisted of a paper by Miss Frances Densmore entitled "The Study of Indian Music" based upon her own recent investigations among the Chippewa of Minnesota. She stated that the object of this study was to find by analysis what constitutes Indian song and musical performance and to make the results of the study available and clear to those who are not musicians but who are interested in the genuine progress of science. Her method of procedure is to make phonograph records of Indian songs, transcribe these, analyze both record and transcription, and tabulate the analyses in accordance with a definite system. Among the interesting results of this work Miss Densmore mentioned the fact that some songs were found to be melodic and some to be harmonic in structure, and also that the rhythm was most peculiar in songs intended to exert a mental influence such as "medicine" songs, certain Mide songs, and also songs intended to incite to war. The paper was illustrated by means of phonograph records and vocal selections to the accompaniment of a drum and the piano. An interesting discussion followed.

JOHN R. SWANTON,
Secretary

SCIENCE

FRIDAY, JUNE 11, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE IONS OF THE ATMOSPHERE[1]

As one of the results of the recent development of electrical science it is considered that throughout the air in its normal state, and in other gases in a similar condition, there exists a small number of molecules, or groups of molecules, which are distinguished from the vast host of their fellows in being electrified. Each of these electrified entities, whatever its structure, is called an ion, and of ions there are two main classes, the one containing those which are positively, the other those which are negatively, electrified. The notion of the ion, in this connection, arises from attempts to reach a simple description of the facts associated with the conduction of electricity through gases, and the hypothesis admirably fulfils its purpose.

The number of ions in the air can be greatly increased by exposing it to the influence of Röntgen rays, or to the radiations from radium or other radio-active bodies, and it is from investigations connected with this artificially produced ionization that most of our present knowledge of ions is derived. For the most interesting account of these researches I refer you to the address delivered before this section at Dunedin in 1904 by the present distinguished president of the association. For my immediate purpose I have to remind you of one result: in an electric field, in addition to the motion of molecular agitation shared by all the constituents of a gas, the ions, in virtue of their charge, acquire a velocity whose average value depends on the electric intensity

[1] Presidential address before Section A of the Australasian Association for the Advancement of Science.

and on the resistance which is offered to the movement; under the influence of the electrical forces the ions drift, as it were, in a definite direction, the positives traveling to the negative electrode, and *vice versa*, a motion in which the uncharged molecules have no part. Other things being equal, it is assumed that this drift velocity of the ions is directly proportional to the electric intensity and following the suggestion of M. Langevin, the term "mobility" has been adopted for the average velocity acquired by an ion under the influence of unit electric force. At the present time the mobility of a class of ions is its most readily determined property, and it is principally to observations of the mobility of the ions in different gases and under various conditions that we must look for a clue to the nature of the ionic structure. In all cases I shall state the value of the mobility as that of the velocity, in centimeters per second, due to an electric force represented by a potential gradient of one volt per centimeter, that is, in practical units.

Two types of ion are recognized as existing naturally in the air, the small ion, with a mobility of about one and one half under normal conditions, and another, discovered by M. Langevin,[2] and called by him the large ion, which is characterized by the very small mobility of only $1/3000$. To these I now add a third, which has a mobility of about $1/100$ under normal circumstances. It may be called, for the present at least, the ion of intermediate mobility, or the intermediate ion.

M. Bloch[3] finds in air bubbled through water ions of mobility of the order of one or two tenths; these seem to form a fourth class of ions and it would be interesting to know if they exist in air not specially treated.

[2] Langevin, *C. R.*, t. 140, p. 232, 1905.

[3] Bloch, *C. R.*, t. 145, p. 54, 1907.

The small atmosphere ions are identical with those artificially produced in air by ionizing agents which have been made the subject of such numerous researches as described by Professor Bragg in his address. There is now considerable knowledge, resumed in the beautiful kinetic theory of gases, of molecular movements and dimensions, and when it is thought that an ion moves more slowly in an electric field than would a single molecule if charged, as the ion must be made of the stuff of the gas in which it is formed, what more natural than to consider it a cluster of a few molecules? This idea has been generally adopted. The small ions are thus assumed to be of somewhat greater size than their fellow molecules, but as the mobility notably increases with decrease of pressure, and with rise of temperature, their diameter is apparently not a constant quantity.

The direct argument, which is used to support this view, considers that in the numerous collisions which occur between the charged and uncharged molecules, in many cases the kinetic energy of the latter will not be great enough to carry them away, after impact, from the attraction of the charge. The charged molecule will thus collect other molecules around it, but as the effect of the charge on the outer members of the cluster diminishes as the collection of molecules increases, the growth will cease when the size is such that the attraction of the charge at the surface of the cluster, in grazing impact of ion and molecule, is just insufficient to hold the latter as a permanent member of the ionic system. The principle involved, in calculating the value of the limiting radius, is similar to that which determines whether a comet, in its close approach to the sun, shall become a permanent member of the solar system or wander into the space from which it came. The calcula-

tion of the ionic size which has been made on these lines assumes the ions as charged, the molecules as uncharged conducting spheres, and, taking the radius of the molecules as 10^{-8} centimeters, reaches the conclusion that the radius of the ion can not exceed three times this value.

To account for the change of mobility associated with alteration of the pressure or temperature conditions, it is supposed that the clusters of molecules forming the ions consist of fewer members at low pressures and at high temperatures than under ordinary circumstances. As the temperature rises, for instance, the ion may be imagined as shedding one by one its component molecules. The mobility, however, varies continuously and not by jumps; it may, therefore, be considered, in addition, that a cluster at any temperature does not always consist of the same number of molecules. In the numerous collisions, to which an ion as a constituent of a gas is subjected, a molecule of the cluster may be lost at one, to be gained at another impact, the cluster acting on the whole as if it contained the average number of members; it is this average number which, from this point of view, must be taken as decreasing continuously with rise of temperature.

From a consideration of the slow movement of the ions in an electric field compared with that which it is assumed a single charged molecule would have in the same circumstances, it is possible, with the aid of the principles of the kinetic theory, to make an estimate of the number of molecules which go to make an ion. The argument is given in Mr. Phillips's paper on "Ionic Velocities in Air at Different Temperatures,"[4] and he calculates from his results that the positive ion at $-179°$ C. consists, on the average, of about four and a half molecules (4.63), while at $+138°$ C. the average number is only about one and a half (1.52). For the negative ion slightly smaller figures are obtained.

[4] Phillips, *Proc. R. S.*, A, 78, p. 167, 1906.

Such an idea of the small ion, based, either on the direct argument in its restricted form already noted, or on the calculation just mentioned, can not be considered satisfactory, and it is now shown to be unnecessary by two workers at opposite sides of the world, Mr. Wellisch at Cambridge and Mr. William Sutherland at Melbourne.

In this connection it is interesting to recall another physical problem which apparently also required for its explanation a shrinkage of the molecules with rise of temperature, that of the relation between the temperature and the viscosity of a gas. The solution of the problem was finally reached in 1893 by Mr. Sutherland, from a consideration of the influence of molecular force in bringing about collisions which would otherwise not occur, the investigation being published in his paper on "The Viscosity of Gases and Molecular Force."[5] The result of mutual attraction, only sensible at small distances, is to make the molecules, considered forceless, behave as if they had a diameter greater than the true value. As the molecular force is less effective in causing collisions the greater the velocity with which two molecules approach each other, the apparent diameter to which it gives rise is less the higher the temperature. It is now shown by the writers I have mentioned that there is a similar effect due to the ionic charge. Owing to the influence of the electrical attraction, collisions between ions and molecules take place which would otherwise be avoided, and consequently the ions act as molecules of greater than the normal size, the apparent diameter decreasing as the temperature rises.

For the movement of an ion through

[5] Sutherland, *Phil. Mag.*, 36, p. 507, 1893.

a gas, M. Langevin[6] has given for the mobility, k, and the coefficient of diffusion, D, the equations,

$$k=\frac{eL}{MV};\quad D=\frac{LV}{3},$$

where e denotes the ionic charge, L the mean free path of the ion, M its mass and V its mean velocity of thermal agitation. Mr. Wellisch in his investigation calculates the mean free path of the ion, taking into account the effect of the ionic charge in increasing the collision frequency, and, substituting in the above equations, reaches general expressions for the two quantities under consideration. If the mass and dimensions of the ion are taken as the same as those of the molecule the expression for the mobility becomes at 0° C.

$$k=\frac{A\eta}{\rho_1 p}\left\{1+\frac{(K_1-1)\pi A^2\eta^2}{2\rho_1 p_1^2}\right\}^{-1}$$

and that for the coefficient of diffusion at the same temperature

$$D=\frac{\eta}{\rho}\left\{1+\frac{(K_1-1)\pi A^2\eta^2}{2\rho_1 p_1^2}\right\}^{-1}$$

where A ($=1.30\times 10^{10}$ electrostatic units) is the product of the number of molecules per cubic centimeter and the ionic charge, η the coefficient of viscosity of the gas, K its specific inductive capacity, ρ the density and p the pressure in dynes per cm.^{2}, the symbols with subscripts referring to values under the standard conditions as to temperature and pressure.

To test the theory Mr. Wellisch gives the following table of comparison between the observed and the calculated values, the observed mobilities, except in the case of air, hydrogen, nitrogen and oxygen, being the results of a series of determinations recently made by him.

Gas or Vapor	Formula	Molecular Mass	$\rho_1\times 10^6$	$\eta\times 10^6$	$(K_1-1)\times 10^6$	k_{760} Calculated	k_{760} Observed +	k_{760} Observed −
Air			129	177	59	1.25	1.36	1.87
Hydrogen	H_2	2	9	86	26	6.32	6.70	7.95
Carbon monoxide	CO	28	125	163	69	1.16	1.05	1.10
Nitrogen	N_2	28	125	163	59	1.31	1 6	mean
Oxygen	O_2	32	143	191	54	1.25	1.36	1.80
Carbon dioxide	CO_2	44	196	141	96	.87	.77	.81
Nitrous oxide	N_2O	44	196	141	107	.81	.79	.86
Ammonia	NH_3	17	76	96	770	.21	.70	.78
Ethyl alcohol	C_2H_6O	46	205	83	940	.19	.32	.26
Sulphur dioxide	SO_2	64	286	122	993	.13	.42	.39
Ethyl chloride	C_2H_5Cl	64.5	288	93	1,554	.11	.32	.30
Ethyl ether	$C_4H_{10}O$	74	330	69	742	.24	.28	.30
Carbon tetrachloride	CCl_4	153.8	686	158	426	.20	.29	.30

Mr. Wellisch further shows that if d denote the coefficient of interdiffusion of a molecule through the gas,

$$\frac{D}{d}=\left\{1+\frac{(K_1-1)\pi A^2\eta^2}{2\rho_1 p_1^2}\right\}^{-1}$$

and by the following table indicates the nature of the agreement between the calculated and observed values.

Gas	$\frac{(K_1-1)\pi A\eta^2}{2\rho_1 p_1^2}$	d Observed[7]	D Calculated	D Observed[8] +	D Observed[8] −
Air	3.70	.150	.032	.028	.043
H_2	5.39	.131	.205	.123	.190
O_2	3.56	.189	.041	.025	.040
CO_2	2.52	.109	.031	.023	.026

Both in the case of the mobility and in that of the coefficient of diffusion the agreement between the calculated and the observed values is, on the whole, quite satisfactory, the conclusion being that the behavior of the ion can be explained on the supposition that it consists of a single molecule associated with a charge equal to that carried by the monovalent ion in electrolysis.

Mr. Wellisch read an account of this investigation of the mobility and diffusion of the ions before the Cambridge Philosophical Society at its meeting held on

[6] Langevin, *Ann. de Chimie et de Physique*, V., 28, p. 289, 1903.

[7] See Jeans, "Dynamical Theory of Gases," p. 253.

[8] Townsend, *Phil. Trans.*, A, 193, p. 129, 1900.

November 9, 1908, and communicates a paper on the same subject to this section.

Mr. Sutherland, to our regret, is unable to be present at this meeting of the association, but he allows me to communicate to the section a letter of his on the theory of the small ion written to me on February 6, 1908, and permits me to mention the results of his investigation at this stage of our proceedings.

Amplifying the discussion developed in his viscosity paper by the addition, in the energy expression, of a term representing the electrical potential energy of ion and molecule when in contact, Mr. Sutherland, in his letter, proceeds to investigate the relation between the mobility and temperature and deduces for the mobility of the ion the simple expression,

$$k = \frac{A\theta^{\frac{1}{2}}}{1 + \frac{C'}{\theta - \theta'}}$$

where A is a constant, θ the absolute temperature, θ' the absolute boiling point, under the experimental pressure, of the substance of the gas in which the ions are formed, and C' a constant similar to that represented by C in his now well-known viscosity formula.

To test the theory Mr. Sutherland applies the equation to the experiments of Mr. Phillips[9] on the negative ion, taking $A = 0.1764$, $C' = 150.5$ and $\theta' = 70$, with the following results:

θ	411	399	383	373	348	333	285	209	94
k calculated	2.48	2.42	2.33	2.27	2.18	2.05	1.75	1.22	.235
k observed	2.49	2.40	2.30	2.21	2.125	2.00	1.78	1.23	.235

As will be noticed, the comparison of the mobility calculated from the above expression with the results of Mr. Phillips's valuable series of observations, shows an accordance well within the limits of experimental error, over the whole range of temperature from 95 degrees to 411 degrees absolute. The apparent decrease in the size of the ion with rise of temperature, as discovered by Mr. Phillips, is thus shown to be due to an effect of the ionic charge similar to that of molecular force which accounts for the apparent shrinkage of the molecules in the viscosity problem.

Mr. Sutherland shows, in addition, how his investigation enables an estimate to be made of the diameter of the ion, and concludes from his determination that most probably the small gaseous ion is the ordinary ion of electrolysis.

Mr. Sutherland's expression for the mobility of the ion, by containing a symbol representing the boiling point of the gas substance at the pressure of the experiment, indicates a dependence of the mobility on the pressure of the gas; the comparison of the values given by it have yet to be compared with the results of experiment.[10]

The idea of the small ion as a cluster of a few molecules, founded on insecure assumptions, was perhaps chiefly characterized by its numerical vagueness; its replacement by a definite theory can not but be regarded as marking a great advance in our knowledge of ionic structure.

Turning now to the consideration of the larger ions in the air, it may be said at once that our knowledge is as yet but represented by the mere collection of the results of experimental investigations. The large ions were discovered by M. Langevin[11] in 1905, who found that their movement, in an electric field with a potential gradient of one volt per centimeter, is only at the rate of one three-thousandth of a centimeter per second, but that, under natural conditions, their number is about fifty times as great as that of the small ions. In a later communication MM. Langevin

[9] Phillips, *loc. cit.*

[10] Langevin, *Ann. de Chimie et de Physique*, t. 28, p. 289, 1903.

[11] Langevin, *C. R.*, t. 140, p. 232, 1905.

and Moulin[12] describe an instrument for automatically registering the ionization of the atmosphere caused by the small and the large ions, with which they have experimented during the past few years; from the use of such an apparatus most important information will be derived.

For some time observations of these large ions, in the air at normal pressure, have been made at the physical laboratory of the University of Sydney. In this investigation I have been joined, at times, by students whose names will be given in connection with the mention of results they have obtained, and throughout have been most ably helped by my assistant, Mr. Carl Sharpe. Owing to the variable character of the natural ionization, the work has proved extremely tedious, as it is only on somewhat rare occasions that a series of observations is accordant enough to give a definite measure of the mobility. The ionization is more uniform after sunset and we observe mainly in the night time.

All our observations have been made with apparatus constructed after the pattern of that used with such success by Professor Zeleny,[13] in his determination of the mobility of the small ions. In such an instrument a uniform stream of air flows through a metal tube which forms the outer conductor of a cylindrical condenser, the ions drifting on to an inner axial electrode, due to the forces in the electric field established between the tube and the axial rod. The theory of the method of finding the mobility with such an apparatus, as given by Professor Zeleny, is well known; it has been followed without modification in calculating the results of the present series of experiments. Greater uniformity in the ionization is obtained if the air, before reaching the measuring tube, is drawn through a considerable length of piping. We have not noticed any effect on the nature of the ions due to the somewhat prolonged contact of the air with the metal of the pipes, and in most of our experiments several meters of iron or of galvanized iron piping have been employed. In all cases Dolezalek electrometers have been used to measure the ionization currents.

During the investigation some definite results have been obtained, of which I propose to give a general account.

In thinking of M. Langevin's discovery the idea must have occurred to many, and is indeed suggested by Professor Rutherford in his book on "Radio-active Transformations," that the large ions may be due to the presence of water vapor. My efforts to elucidate this point have resulted in finding that there is a definite relation between the mobility of the ion and the amount of moisture in the air.

When a current of air is passed over hygroscopic substances, without mechanical filtration, Mr. S. G. Lusby finds that large ions are absorbed and has noticed a loss in number amounting to 55 per cent., after the air had flowed over a tray containing phosphorus pentoxide. I find, in addition, that after leaving the drying agent, those large ions which still exist in the air decrease in mobility with time, and that when the relative humidity changes from 80 to 4 per cent., at a temperature of 19° C., they are not in equilibrium with the new vapor pressure conditions until after the lapse of about twelve minutes. Owing to the variable nature of the natural ionization, and perhaps to other causes, the calculated mobilities exhibit considerable irregularities, but show in an unmistakable manner, when the equilibrium state is established, a dependence of the mobility on the amount of water vapor in the air, the relation between the two

[12] Langevin and Moulin, *Le Radium*, 4, p. 218, June, 1907.

[13] Zeleny, *Phil. Trans.*, A, 195, p. 193, 1900.

quantities being apparently a linear one between the limits of the absolute humidity represented by 0.5 and 19.0 (grms./m^3), corresponding to relative humidities of 4 and 100 per cent. The mean mobilities for these values of the humidity, from results so far obtained, are 1/1280 and 1/3370, respectively. In other words the mobility for an absolute humidity of 2.4 is twice as great as that for a humidity of 15.4 (grms./m^3). The observations are not regular enough to show if there is any difference between the mobilities of the positive and negative ions. Owing to ionization being caused by phosphorus, it is not advisable to use phosphorus pentoxide as the drying agent in such experiments, and calcium chloride has been employed in all cases.

The intermediate ion has been under observation for only a comparatively short time. The measures so far made, however, show that the mobility is largely affected by change of the humidity of the air, the magnitude varying from one fifteenth to about one tenth of that number as the absolute humidity alters from 0.5 to 15 (grms./m^3) at a temperature of about 22° C. To this statement there is a limitation, the extent of which I do not as yet fully know—in air in its natural state with the absolute humidity between 14 and 16 grms./m^3, at 22° C. when the ionization due to this class of ions is relatively weak, the mobility, at least of the positive ions, is of the order of 1/65, while with strong ionization the value is only about half as great. Unless the limitation just mentioned provides an exception, on further investigation, no definite difference between the mobilities of the positive and negative ions of this class can be deduced from the observations.

The facts just described prove that there is a definite connection between the ions and the water vapor of the air, and open up an interesting field for speculation as to the development and structure of electrified clusters, and as to the nature of the resistance which they experience in drifting through the crowd of molecules. The basis of the structure is, of course, the molecular ion, which, it is well known, originates from effects associated with radio-active transformations occurring in the air, the ionization being primarily due to the presence of radium and thorium in the material of the earth's surface. The growth to more complex structure apparently occurs by the collection of water molecules round the molecular ion, owing to the influence of its charge.

Seemingly from a consideration of the experimental results, we must recognize at least two forms of electrified molecular aggregation in the air which are stable under ordinary conditions. As the mobilities depend on the humidity, it might not unreasonably be supposed that the intermediate and large ions represent stages in the development of the small ions into visible drops of water, which occurs if the air becomes sufficiently supersaturated. It seems, therefore, curious that the large ions are not separately apparent as condensation nuclei in cloud experiments.

Mr. C. T. R. Wilson[14] has shown that in such experiments the presence of a moderate electrical field prevents the formation of drops if the expansion ratio does not exceed the value 1.27. This proves that the nuclei for these small expansions are ions which can be removed by the field before the expansion takes place. I have carefully repeated the observations, with an apparatus similar to that described by Mr. Wilson, in order to determine if the effect of the electric field varies with the time it is on before expansion, and find the full effect whether the interval is one second or twenty minutes. With the fields

[14] Wilson, *Phil. Mag.*, June, 1904.

used it takes several minutes to remove all the large ions, on account of their small mobility, whereas the small ions disappear in less than a second, so the nuclei for the drops formed with expansions below 1.27 are small, not large ions. To test whether the large ions become visible at a lower humidity than that at which the small ones appear, Mr. E. P. Norman, at the Sydney University Laboratory, has repeated Mr. Wilson's experiments on the supersaturation required for condensation,[15] with natural air over mercury. Commencing with a humidity between 60 and 70 per cent., after removing the "dust," no condensation occurs, not only below saturation, but not until the supersaturation becomes four-fold, as in the earlier experiments over water. In all our experiments the observations have been repeated with air which has remained undisturbed in the apparatus overnight, in order that time might be available for the reproduction of the large ions if they had been initially withdrawn, but the results of the first expansion in the mornings appeared in no case different from those of the later ones. Now Mr. Lusby finds, using two Zeleny tubes in series, joined by earthed piping whose length can be varied, that if all the large ions are removed from a stream of air by the first tube, they are fully reproduced in number in about 22 minutes. Our failure to detect the large ions is not, therefore, because they were removed with the "dust," unless, indeed, large ions are not produced in closed vessels, a matter which it would be difficult to determine.

Considering that in natural air the large ions are fifty times more numerous than the small ones, it is hard to reconcile the fact that the separate existence of the former has never been suspected in condensation experiments with the idea of the large ion as representing a stage in the growth of the small one to a condition of visibility, and the experimental evidence as to the position of the large ion in this connection seems as yet in an unsatisfactory state.

MM. Langevin and Moulin[16] describe the small and the large ions as playing different parts in the formation of natural clouds, but the statement is merely one of suggestion.

As all the ions have the same charge, the electrical state of the atmosphere is conditioned by the numbers of the ions of each class which exist at the time. Should the numbers of positives and negatives be equal the air is electrically neutral, if, however, one kind greatly outnumbers the other the air is thereby highly electrified.

The number per cubic centimeter, or the specific number, as it may be called, of each class of ions in the air is an extremely variable quantity, particularly in the day time. From measurements in other parts of the world it is considered that the specific number of the small ions varies between 500 and several thousands. Between this estimate and that given by my own experience there is an amazing discrepancy. In a series of 128 observations, taken at Sydney in the early part of the year 1907, the maximum specific number is 157, the minimum zero, the mean number for the positives being 39 and that for the negatives 38. The European determinations are based on observations taken with Dr. Ebert's well-known ion counter, the principle of the apparatus being that of the Zeleny tube. With our present knowledge of the existence of the intermediate ions, it can readily be shown that the inner electrode of the instrument is altogether too long. The apparatus, as ordinarily employed, catches not only the small ions, but a proportion of the others as

[15] Wilson, *Phil. Trans.*, A, 189, p. 265, 1897.

[16] Langevin and Moulin, *loc. cit.*

well. Calculating with my own measures of the mobilities and specific numbers, it appears that the determination of the specific number of the small ions from the indications of the Ebert instrument must be from two to four times too great. As for the remaining part of the discrepancy, having used Dolezalek electrometers in my own observations, I may, perhaps, be prejudiced in thinking that the metal leaf electroscope of the Elbert apparatus is an unreliable appliance for use in such determinations; in any case the matter must be made the subject of a special enquiry, but in the meantime I have the utmost confidence in my own measures.

With regard to the other ions, from the very limited series of observations which I have as yet made of the intermediate ones, in air in its natural state, what I have previously called relatively strong ionization is represented by about one thousand per cubic centimeter, while for the relatively weak ionization the number is about two hundred.

For the specific number of the large ions, a series of 117 observations gives 5,500 as the maximum and 600 as the minimum, the mean for the positives being 1,914 and for the negatives, 2,228.

The numbers given, with the exception of those for the intermediate ion, are the results of measures with air drawn directly into the testing apparatus without the intervention of any pipes; later observations give much higher values for the specific number of the large ions in air led through a considerable length of piping.

It is now well known, since Lord Kelvin's memorable work on the subject, that a potential difference exists between the earth's surface and the upper layers of the atmosphere. In the electrical field, which is thus indicated, the ions in the air move more or less steadily in a vertical direction, the negatives ordinarily traveling upwards, the positives downwards to the earth. Such a movement constitutes a vertical electric current in the air, the magnitude at any time depending on the air's specific conductivity and the value of the potential gradient at the moment. The specific conductivity is represented by the sum of the continued product of the specific number, the mobility, and the charge for each class of ion. An instrument designed by Dr. Gerdien, in which an electroscope is used as in the Ebert apparatus, has been universally employed for such determinations as have been made of this important quantity. It measures the sum of the conductivities due to each type of ionization, and the calculation of the result from observations with the apparatus is not affected by the discovery of a new class of ions. The complexity of the natural ionization, however, prevents the instrument being used to accurately determine the specific number of the small ions. The average value of the specific conductivity of the air in other parts of the world, as given by the Gerdien apparatus, is about 10^{-4} in electrostatic units.[17] The magnitude of this quantity can be calculated from the measures of the mobilities and specific numbers of the ions, and the average specific conductivity of the air at Sydney, so determined, is only about one tenth of the value just stated. Here again there is a considerable discrepancy between my own and other measures which has yet to be investigated.

With increasing knowledge we can look forward to developments of importance to meteorology in connection with ionic observations; just now it is doubtful, I think, if valuable effort is not being wasted as a result of over-confidence in the present state of the art.

[17] Gerdien, *Gesell. Wiss. Gottingen, Nachr.*, Math-Phys. Klasse, 1, p. 77, 1907. Dike, *Terr. Magn. and Atmos. Elect.*, September, 1908.

Such is a sketch of our present knowledge of the ions of the atmosphere. With the publication of Mr. Wellisch's and Mr. Sutherland's investigations we have reached a definite idea of the small ion in air—a molecule, which, as the attraction of its charge brings about collisions which would otherwise not occur, acts as if it were one of more than the normal size—the conception enabling our experience to be not only simply but exactly described. Of the large ions, no such definite picture can as yet be drawn. Ions similar in character have been observed in gases from flames and in other cases, and it is to be hoped that the material which is now being collected may soon prove sufficient, in the hands of those specially skilled in the methods of the kinetic theory of gases, for a discussion of the life history of these molecular clusters. The study of the natural ions has a special interest, as a wider determination of the facts of the ionization of the air means an advance towards a more comprehensive knowledge of atmospheric electricity.

J. A. Pollock

University of Sidney

THE ELIZABETH THOMPSON SCIENCE FUND

The thirty-fourth meeting of the board of trustees was held at Harvard College Observatory, Cambridge, Mass., on April 29, 1909. The following officers were elected:

President—Edward C. Pickering.
Treasurer—Charles S. Rackemann.
Secretary—Charles S. Minot.

It was voted to close the records of the following grants, the work having been completed and publications made: No. 115 to H. S. Carhart, and No. 128 to L. J. Henderson; and to close upon receipt of publications the accounts of the following grants: No. 96, H. E. Crampton; No. 108, E. Anding; No. 112, W. J. Moenkhaus; No. 126, L. Cuénot; and No. 132, W. G. Cady.

Reports of progress were received from the following holders of grants:

No.		No.	
98.	J. Weinzirl.	137.	C. H. Eigenmann.
111.	R. Hürthle.	138.	Mme. P. Šafarik.
117.	E. Salkowski and C. Neuberg.	139.	J. Koenigsberger.
		140.	K. E. Guthe.
119.	J. P. McMurrich.	141.	J. T. Patterson.
123.	E. C. Jeffrey.	142.	W. J. Hale.
131.	F. W. Thyng.	143.	R. W. Wood.
133.	J. F. Shepard.	144.	G. A. Hulett.
135.	A. Negri.	145.	J. de Kowalski.
136.	H. A. Kip.	146.	M. Nussbaum.

The secretary stated that during the past year no reports had been received from the following holders of grants:

22, 27.	E. Hartwig.	121.	A. Debierne.
109.	A. Nicolas.	124.	P. Bachmetjew.

It was voted to make the following new grants:

No. 147. $200 to Professor Johannes Müller, Mecklenburg, Germany, to investigate the physiological chemistry of inosit.

No. 148. $200 to Professor C. C. Nutting, Iowa City, Iowa, for a report on the Gorgonacea of the Siboya Expedition.

No. 149. $200 to Professor Ph. A. Guye, Geneva, Switzerland, for determinations of atomic weights.

No. 150. $100 to Professor Charles A. Kofoid, Berkeley, Cal., for an investigation of the life history of the Dinoflagellates.

No. 151. $150 to Professor Otto v. Fürth, Wien, Austria, for a research concerning the relation of the internal secretion of the pancreas to the general metabolism and especially to the combustion of carbohydrates.

No. 152. $150 to W. D. Hoyt, Esq., Baltimore, Md., to study the fruiting of the marine alga, *Dictyota dichotoma*.

No. 153. $250 to W. Doberck, Esq., Sutton, England, for a position micrometer to be used in astronomical observations.

No. 154. $100 to Dr. J. P. Munson, Ellensburg, Washington, for an investigation of the minute structure of the chelonian brain.

Charles S. Minot,
Secretary

THE RETIREMENT OF PRESIDENT ELIOT

The faculty of arts and sciences of Harvard University has passed a minute on the services of President Eliot which reads as follows:

The faculty of arts and sciences records with gratitude its sense of the services which Charles William Eliot has rendered to Harvard University and to its own members. The changes he has wrought in the university will be remembered so long as the university endures. To this faculty he has been a guide and a friend no less than a leader. The qualities which mark him as great have nowhere appeared more clearly and spontaneously than in its meetings. He has shown judgment and resource, devotion to progress, love of truth, contempt for sham and indirection, and patience with those who differed or opposed. He has welcomed in catholic spirit every variety of intellectual ability, and has furthered the extension of every field of knowledge. He has been frank in the admission of evils, courageous and skilful in seeking for remedies; unfailingly attentive to every detail, always mindful of the large question of policy; cogent and effective in debate, generous toward the arguments of others. In the university and in this faculty, as in the outer world, he has stood for freedom of opinion and expression. He has been a leader not through official position but by force of character and intellect. His dealings with the teaching staff have been open, equitable and liberal to the extent of every available resource. His close contact with the members of the faculty has deepened in their hearts, with every added year of his long term, confidence, admiration and warm regard; and they now part from him with reluctance, but with thankfulness for what has been achieved by him and under him, and with faith that his work will be maintained.

THE WINNIPEG MEETING OF THE BRITISH ASSOCIATION

THE local secretaries for the meeting of the British Association for the Advancement of Science beg to remind intending visitors from the United States that members of the American Association for the Advancement of Science will be admitted as full members of the British Association for the Winnipeg meeting (and entitled to receive the volume of proceedings), on payment of a fee of \$5. The meeting will be held from the twenty-fifth of August to the first of September, inclusive, and it is anticipated that a large number of visitors from the United States, as well as from Canada and Europe, will attend. It is important that those intending to be present should send in their names to the local secretaries, University of Manitoba, Winnipeg, as soon as possible; printed matter bearing on the meeting will gladly be furnished, as well as postcard forms giving various details of use to the local committee. The secretaries are in communication with the various passenger associations in connection with reduced fares via the United States, but for the present no definite statement can be given, except that the special fares in force in connection with the exposition at Seattle may be taken advantage of. A concession of single fare for the return journey has been secured on all Canadian railways, and those entering Canada should be able to obtain from the agent at the port of entry the standard convention certificate enabling them to secure this privilege. Circulars of information upon this and other matters will be forwarded upon application to the local secretaries.

SCIENTIFIC NOTES AND NEWS

DR. IRA REMSEN, president of the Johns Hopkins University, has been elected president of the Society for Chemical Industry for the meeting to be held next year in Glasgow.

MR. LAZARUS FLETCHER, F.R.S., the keeper of the department of mineralogy since 1880, has been appointed to the post of director of the natural history departments of the British Museum, vacant since the retirement of Dr. E. Ray Lankester.

AMONG the honorary degrees awarded by Columbia University at its recent commencement was that of master of science on Mr. B. B. Lawrence, the mining engineer; a doctorate of science on Dr. S. F. Emmons, of the U. S. Geological Survey; a doctorate of letters on Dr. Mary Whiton Calkins, professor of philosophy and psychology at Wellesley College, and a doctorate of laws on Dr. A. Lawrence Lowell, president of Harvard University.

NEW YORK UNIVERSITY has conferred its doctorate of laws on Dr. Borden P. Bowne, professor of philosophy in Boston University.

DR. S. O. MAST, associate in biology at the Woman's College of Baltimore, has received

the Cartwright prize of $500 for his work on "The Effect of Light on the Movements of Lower Organisms," awarded by the College of Physicians and Surgeons, Columbia University.

THE Linnean Society has presented its gold medal to Dr. F. O. Bower, F.R.S., regius professor of botany in the University of Glasgow.

PROFESSOR W. F. OSGOOD, of Harvard University, has been elected corresponding member of the Mathematical Society of Charkow.

M. E. BOUDIER has been elected a corresponding member in the Paris Academy of Sciences in the section of botany.

DR. GEORGES DREYER, professor of pathology in the University of Oxford, has been elected a member of the Danish Royal Academy of Letters and Science.

DR. W. W. DANIEL, professor of chemistry at the University of Wisconsin, has retired from the chair which he has held since 1868. His former students have presented the university with a portrait by Mr. J. C. Johansen, of New York.

THE trustees of Columbia University have awarded the Ernest Kempton Adams research fellowship, for the year 1909–10, to Professor C. W. Chamberlain, of Vassar College.

AT a meeting of the board of directors of the Rockefeller Institute for Medical Research, held on May 29, the following promotions and appointments were made: Associate, Paul A. Lewis (pathology); Assistant, F. Peyton Rous (pathology); Scholar, Angelia M. Courtney (chemistry).

DR. C. D. PERRINE, of the Lick Observatory, has proceeded to Buenos Ayres to assume the directorship of the Argentine National Observatory at Cordobe, vacant by the death of Dr. Thome. His address will be Observatorio Nacional, Cordoba, Argentina.

THE secretary of the Smithsonian Institution and Mrs. Charles D. Walcott sailed on June 5 to attend the commemoration of the centenary of the birth of Charles Darwin as the representative of the institution. During his stay in Great Britain, Dr. Walcott will visit the northwest coast of Scotland to collect and study specimens of Cambrian fossils found in that locality. He will return to Washington on July 3, after which he will proceed to British Columbia to continue there his field work.

PROFESSOR L. H. BAILEY, director of the College of Agriculture, Cornell University, has leave of absence for next year. Professor Herbert J. Webber will act as director.

DR. A. M. TOZZER, of Harvard University, has been given leave of absence for 1909–10 to carry on archeological investigations in Guatemala.

DR. NETTIE M. STEVENS, associate in experimental morphology at Bryn Mawr College, who has been studying at the Zoological Station in Naples and the University of Würtzburg as the Alice Freeman Palmer research fellow for the year 1908–9, will resume her work at the college next year.

DR. PAUL C. FREER, director of the Bureau of Science, Manila, has left, in April, for Europe by the Trans-Siberian route. Dr. Freer will spend some time studying the laboratory methods of the leading scientific institutions of Europe. He will return to the Orient after two months in this country.

DR. CHARLES L. EDWARDS, professor of natural history at Trinity College, will spend next year in Europe.

DR. F. O. GROVER, professor of botany at Oberlin College, will spend next year abroad.

LIEUTENANT SHACKLETON is expected to reach England about the middle of June. Several members of the *Nimrod* expedition have reached England, including Mr. Raymond E. Priestley, of Bristol, the geologist; Mr. G. E. Marston, of London, the artist; Mr. Ernest Joyce, London, who was in charge of the supporting party; Mr. Frank Wild, of Bedfordshire, who accompanied Lieutenant Shackleton furthest south, and Mr. Bernard Day, of Leicester, who had charge of the motor car.

DR. HENRY P. WALCOTT, chairman of the Massachusetts State Board of Health, will preside at the International Congress of Hygiene and Demography, which it is proposed to hold in Washington next year.

DR. W. H. HOWELL, dean of the Johns Hopkins Medical School, will give the anniversary

address at the Yale Medical School, his subject being "The Medical School as Part of the University."

DR. CHARLES S. MINOT, of the Harvard Medical School, delivered on May 27, at St. Louis, the commencement address in medicine for Washington University. The address was entitled "On Certain Ideals of Medical Education," and will be published shortly.

DR. DICKINSON S. MILLER, professor of philosophy at Columbia University, will give the Phi Beta Kappa address at Hobart College.

PROFESSOR I. WOODBRIDGE RILEY, of Vassar College, delivered the annual address before the American Medico-Psychological Association at Atlantic City on June 2. The subject was "Mental Healings in America."

The Electrical World states that an unfortunate complication has arisen concerning the location of the memorial statue to Lord Kelvin in his native city of Belfast. It has been decided to erect the statue in the grounds of the Queen's College, but it was subsequently pointed out that such use of the grounds would be legally a breach of trust under the terms of tenure of the property. In the meantime, some of the subscribers to the memorial have served formal notice restraining the Lord Mayor from expending any of the money subscribed until the questions regarding the site have been satisfactorily determined.

DR. WILHELM ENGELMANN, professor of physiology at Berlin, has died at the age of sixty-five years.

DR. GEORGE VON NEUMAYER, the eminent meteorologist, has died at Neustadt at the age of eighty-three years.

TABLES at the laboratory of the United States Bureau of Fisheries, at Beaufort, North Carolina, will be available for the use of investigators after July 1. Requests for further information should be addressed either to the commissioner of fisheries, Washington, D. C., or to the director of the laboratory, Beaufort, N. C.

THE third annual geographical conference was held, on the invitation of Professor Davis, in the Geographical Laboratory of Harvard University on Saturday, May 29, and was attended by over forty teachers from the schools of Boston and neighboring cities. Recent proposals regarding the teaching of geography in secondary schools were discussed, and an excursion to the coastal plain of Maine was planned for June 26.

AT the last meeting of the International Physiological Congress, which was held at Heidelberg, in 1907, it was decided to hold the next Congress at Vienna in 1910, at Whitsuntide. The *British Medical Journal* states that it has been found that at this time of the year it would be impossible for a large number of physiologists to attend the congress, and the local committee of the congress at Vienna has therefore, after consulting the local secretaries in the various countries, determined to change the date of the congress. In accordance with the general wish, it will be held from September 26 to 30, 1910.

IT has been arranged to transfer the whole of the Vatican Observatory to the summit of the Vatican Hill, 100 meters above the square of St. Peter's, where a section of the observatory has been for some years.

FOREIGN papers state that the central committee of the Austrian Alpine Club has by the authorities of Munich been put in possession of a large building with excellent accommodation and well situated on the banks of the Isar. The club proposes to inaugurate an Alpine museum in its new building.

THE Pacific coast will soon be the scene of an interesting tree-growing experiment. The United States Forest Service is planning to introduce a number of the more important eastern hardwoods into California, and will this year experiment with chestnut, hickory, basswood, red oak and yellow poplar or tulip trees. Small patches of these trees will be planted near the forest rangers' cabins on the national forests, and if these do well larger plantations on a commercial scale will soon be established on wider areas. There are over 125 different species of trees in California, a number of which produce some of the most valuable varieties of lumber in the country. Although considerably over one half of the species are hardwood or broad-leaved trees, yet, with the exception of the exotic eucalyptus,

there is not a single species of hardwood here ranking in commercial importance with the leading eastern hardwoods. Climatic conditions in many parts of California are favorable for the growth of a number of the valuable hardwoods, and the absence of these trees is due mostly to unfavorable factors of seed distribution.

UNIVERSITY AND EDUCATIONAL NEWS

The General Education Board has offered to give the Johns Hopkins University $200,000 on condition that a million dollars be raised for the removal of the university to its new site at Homewood.

Mr. N. W. Harris has promised to give Northwestern University $155,000 if the college will procure the remainder of a million dollars during the coming year.

The New York *Evening Post* states that Mrs. D. G. Richardson, who in the past has contributed liberally to the medical school of Tulane University, has recently given property valued at $55,000, and yielding an income of $3,000 for the endowment of the chair of botany. Professor R. S. Cocks fills the newly created chair.

The debt of Columbia University contracted in part payment of its new site and buildings has been funded, and the United States Trust Company has taken a mortgage of $3,000,000 on the blocks owned by the university on Fifth Avenue between forty-ninth and fifty-first streets. The university will pay off this debt in thirty annual installments.

Professor Irving Hardesty, the head of the department of anatomy at the University of California, has been appointed to the head of the department of anatomy in Tulane University, Louisiana.

Dr. George H. Ling, adjunct professor of mathematics at Columbia, has accepted the professorship of mathematics in the newly-established University of Saskatchewan.

Dr. Frank G. Speck, instructor in anthropology, has accepted the position of assistant professor of anthropology in the University of California.

Walter K. Van Haagen, assistant in chemistry at Lehigh University, has been elected associate professor of chemistry at the University of Georgia.

Professor J. A. Brown has resigned his position at Dartmouth College to accept the chair of physics at the Protestant College of Beirut, Syria.

Mr. Charles B. Gates, assistant in chemistry at the University of Wisconsin, has been chosen instructor in chemistry at the Michigan College of Mines.

Professor G. Elliot Smith, F.R.S., of the Government School of Medicine, Cairo, has been appointed to the chair of anatomy in the University of Manchester.

DISCUSSION AND CORRESPONDENCE

ON THE TEACHING OF THE ELEMENTS OF EMBRYOLOGY

In 1893 Professor A. Milnes Marshall wrote in the preface to his "Vertebrate Embryology":

> Great attention has of recent years been given to the study of embryology, and yet it is curiously difficult to find straightforward accounts of the development even of the commonest animals. . . . In works professing to deal with human embryology it is more common than not to find that the descriptions, and the figures given in illustration of them, are really taken, not from human embryos at all, but from rabbits, pigs, chickens or even dogfish.
>
> This latter practise is a most unfortunate one, and has been the cause of much confusion. The student is led to suppose that our knowledge is more complete than is really the case, while at the same time he finds the greatest difficulty in obtaining definite information on any particular point in which he is interested.

This very temperate statement needs to be repeated to-day with greater emphasis, for the attention given to the study of embryology has increased with the years; it is required from practically every student of medicine and of biology, and it is as difficult as ever, if not more so (for old accounts grow out of date), to find straightforward accounts of the development even of the commonest animals. Now, as then, our text-books leap from fish to man, back to *Amphioxus*, and forward again, with stops at intermediate stations, amphibians, reptiles and birds, in such a way as to

confuse the student seriously. His confusion is increased if he compares different books, for they are apt to select different illustrations from the unlimited body of facts; and statements are often contradictory. Moreover, it is frequently impossible to say when the description passes from one form to another, or indeed, what species of animal, or pale phantom of the imagination, is in the author's mind at all.

The distinction between fact and theory is a useful one, even in embryology; indeed, I know of no distinction so important for the student to master. But in the text-books of embryology there is a nebulous zone between peopled with morulæ, blastulæ, gastrulæ, germ-layers, etc., which dissolve and reappear in strange forms never the same. And the student is often uncertain whether he is on the sure ground of fact, in the fascinating field of theory or in the twilight zone between. Such uncertainty is demoralizing, because it limits his respect for exact facts and does not increase his capacity for sound generalization. The student who gains his conception of a developmental sequence by combining the morula of a mammal, the blastula of a starfish, the gastrula of *Amphioxus* and the germ-layers of a frog is as far removed from connected facts as from sound theory.

Such method of the text-book is of course ill-adapted to laboratory practise and there is usually a gap between. The student's laboratory practise is usually limited to an anatomical study of a few stages of one or a few forms, and if he turns to the text-book to bind his observations into a sequence, he finds brief superficial descriptions of disconnected stages of a great variety of forms, for the most part, of course, different from those he is studying in the laboratory. Neither in his laboratory practise nor in his text-book does the student obtain genuine understanding of the development of any single form. It would be just as reasonable to expect proper comprehension of the principles of comparative anatomy of vertebrates without knowledge of the anatomy of any definite species as to expect real understanding of the principles of comparative embryology from a student who does not know a single life history thoroughly.

These conditions are seriously aggravated by secondary considerations of the text-books, such as the alleged greater significance of certain aspects of the life history for various practical disciplines, which leads to unjust emphasis, and to the view that embryology is a field from which only facts of practical value are to be culled; I am far from denying the significance of the study of embryology for medicine, for instance, but I would maintain that much of its significance is lost by piecemeal selections. If the facts and principles are understood, the applications may be readily made at the proper time and place, but if they are not understood the applications are surely of doubtful value.

Theory changes so rapidly in embryology that text-books soon grow out of date; and tastes differ so widely that the selection of facts for a book fails to satisfy more than a limited number of teachers. Hence the constant procession of text-books of embryology. In this state of affairs there is bound to be a reaction, and it appears to me that this must take the form of a series of text-books dealing with the concrete development of single forms.

Probably no text-book of embryology has been so influential and of so long continued service as Foster and Balfour's "Elements of Embryology," of which the first edition was put forth in 1873, and the second edition (enlarged) in 1883, soon after Balfour's untimely death. Even now, although it has not been revised for twenty-six years, it is still in active service. The reason for this lies partly in the simplicity and clearness of the style, but largely in the fact that the greater part is a literal account of the development of a single form, the chick; it takes up the events of the development of each day, to the end of the sixth day at least, "as though the development were done by day labor," which is indeed the case, and the student obtains some idea of time-relations which are of the essence of embryonic development; he is made to see development as a continuous process marching steadily forward to a definite consummation;

and he controls the statements of the book by his observations in the laboratory; and where the latter are incomplete they can be supplemented by reference to the former.

The continued usefulness of this little book is an object lesson in embryological pedagogy by which the writer tried to profit in writing a new "Development of the Chick" which should bring the subject matter up to date, and serve as an introduction to embryology. On the whole it seems improbable that the chick will be displaced as the favorite subject for laboratory practise in embryology, because the material is of universal occurrence and available at all seasons of the year without great expense. Moreover, the technique is as simple as that of any other form, at least after the egg is laid; and the knowledge of its development, while yet incomplete, is certainly more considerable than that of any other animal with the possible exception of man himself.

Professor Metcalf's objections to the use of the chick for introducing students to the subject of embryology[1] do not appear to me to be well grounded. He complains that the embryo chick is "highly specialized" and "distorted from the general vertebrate type," and that "the space relations of the organs are distorted by secondary influences." For these reasons he prefers the frog, and wishes that there were an embryology of this form. I echo this wish and hope that Professor Metcalf will undertake to write one. I am afraid, however, that the inconsiderate agriculturalists who domesticated the hen and taught her to lay the year around have conferred on her an unfair advantage; and it appears to me better for the elementary student to study living hens' eggs than preserved frogs' eggs. This is indeed the main advantage that I see on the side of the chick. But I believe that the objections on account of "specialization" and "distortion" are more deeply rooted in tradition than in nature.

But whether the student uses the frog or the chick, or some other form, he needs a fairly complete and modern book of reference of the same form, if not to replace, at least to supplement, the comparative text-books. In this contention I think Professor Metcalf will agree. We need above all objectivity in the teaching of embryology; we must require some basis of exact facts to support generalizations, and keep the distinction between the two clear in the student's mind.

[1] SCIENCE, N. S., XXIX., May 7, 1909, pp. 738–739.

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GENERA WITHOUT SPECIES

IN SCIENCE for February 26, 1909 (pp. 339, 340), Professor Cockerell discussed the "controversy" concerning "genera without species," pointing out the difficulty of dealing with such cases, since they are not distinctly provided for in the International Code of Zoological Nomenclature. Apparently each case should be dealt with solely on its merits. A few illustrations may help to make this point clear. In 1799 Lacépède proposed the genus *Picoides*, giving a short diagnosis of it, but omitting to refer to it any species. The diagnosis clearly indicates a woodpecker having only three toes. The only species of woodpecker at that time known with only three toes was the three-toed woodpecker of northern Europe, *Picus tridactylus* Linn. This species being clearly the basis of the diagnosis, it may be taken as the type of the genus *Picoides*, now, for a long time, current for the group containing this and other closely allied species.

In the same way, and at the same date, Lacépède proposed the name *Astur* for a genus of short-winged, long-legged hawks, giving for the genus a wholly inadequate diagnosis, without mentioning under it any species. In 1806 Froriep published a German translation ("Analytische Zoologie") of Duméril's "Zoologie analytique," adding to it, *passim*, much new matter, including the mention of examples under Duméril's genera, which, for the most part, were originally proposed by earlier authors, without, of course, the designation of types. As an example of *Astur* Froriep gave the species *Falco palumbarius* Linn., which thus may be taken as the type of *Astur*. But the genus should date

from Lacépède, 1799, and the type from Froriep, 1806. The genus has been current for more than a century, during which period the same species has been repeatedly and independently designated as its type by various subsequent authors.

Forster in 1788 published a work ("Enchrid. Hist. Nat.") in which he gave diagnoses of the genera of birds (and other animals) then known to him, but without referring to them any species. Some of them were for the first time characterized and named, among them the genus *Gavia*. His diagnosis, with the context, shows unequivocally that *Gavia* was proposed for the loons, a group comprising, as now known, some half-dozen species, all strictly congeneric, and so different from all other birds as to constitute a distinct superfamily. *Gavia* was, furthermore, the first generic name proposed for the group. It only remained for some one later to select some one of the loon species as its type.

Muscivora was proposed by Lacépède in 1799, for a genus of tyrant flycatchers, but he referred to it no species. It was not satisfactorily determinable till a species was referred to it by G. Fischer in 1813.

Cuvier in 1800 published ("Leç. d'Anat. comp.," tab. ii.) a considerable number of genera now currently accepted from this source, without giving either diagnoses or other basis for them beyond citing their equivalent vernacular French names, which names are, however, identifiable from a slightly earlier work ("Tabl. élém. de l'Hist. nat.," 1798) of the same author where these vernacular names are coupled with their proper technical designations. In a few cases his generic names are not thus identifiable, and are hence to be ignored.

These examples, selected from many that are available,[1] seem to show clearly that "genera without species" should be dealt with according to their individual merits. They seem also to fully answer Professor Cockerell's question, "Who can define a genus except as including species?"

It may be noted further that while this question is not considered in the International Code, it is fully discussed and provided for in the A. O. U. Code, where a diagnosis is recognized as a valid basis for a generic name, with the provision, however, that "a name resting solely on an inadequate diagnosis is to be rejected, on the ground that it is indeterminable and therefore not properly defined." This ruling is based on general usage for nearly a century, as well as on common sense; to reject it would result in the overthrow of many generic names that have been current in vertebrate zoology for almost a century. It may be added that while the A. O. U. Code of Nomenclature and the International Code of Nomenclature are in perfect accord in respect to principles and spirit, the A. O. U. Code is much fuller and more explicit than the International, taking up in detail a large number of questions not included in the latter. This may well be the case, inasmuch as the A. O. U. Code is a document of some fifty pages while the International Code is comprised in a dozen pages.

Postscript.—Since the above was sent to SCIENCE, Professor Cockerell has returned to the subject of "Genera without Species,"[2] giving abstracts of replies received by him from a number of correspondents in response to a suggestion to that effect made in his former communication.[3] These replies are not only interesting, but possess some importance as showing the opinions on this question of a number of entomologists and botanists. The twelve gentlemen here represented seem to pretty unanimously agree with Professor Cockerell that (to quote from one of them) "generic names published without any mention of included species are to be regarded as invalid"; or, as otherwise stated, "are nomina nuda." This remarkable unanimity seems to me to be due either to limited experience in this difficult field, or to a lack of knowledge of

[1] For example, Lacépède, in his "Tableau . . . des Oiseaux" (1799), recognized 130 genera of birds, of which 19 were here first proposed, all solely on the basis of diagnoses; of these 11, or more than one half, are now, and always have been, in universal use; the others were homonyms or preoccupied names.

[2] SCIENCE, May 21, 1909, pp. 813, 814.

[3] SCIENCE, February 26, 1909, p. 340.

the history of nomenclature; in other words, as off-hand opinions as to what seemingly ought to be, regardless of the actualities of the case.

Nomenclature (both zoological and botanical) has attained its present stage of comparative orderliness by slow stages of development. For the first seventy years of its history such a concept as a "genotype" appears to have been rarely, if ever, thought of; and it was not until the first quarter of the nineteenth century had passed that types of genera began to be considered as a necessary part of the proper basis of a genus. Prior to 1810 hundreds of genera now in current use were proposed solely on the basis of a diagnosis; although they were accepted and have been in use from the date of their proposal, many of them were without designated types for half a century. Yet the authors of this early period were in substantial agreement as to what groups of species these generic names were intended to include. From the modern viewpoint these genera were (usually) heterogeneous groups, each comprising several modern genera. In the process of division a type was sooner or later, by restriction or by actual designation, assigned to the original genus. Not till then did the genus, from the modern viewpoint, become properly established. Many other genera of this early period, similarly proposed, are unidentifiable. I can not agree that these two categories should have the same treatment. Nor can I agree that a long-accepted genus must date from the author who, long after it was originally founded, "validated" it by designating a type for it; but rather, as indicated in the first part of this communication, that the genus should date from its founder. Otherwise nearly all of the early genera for birds would date from about 1840, after many of them had been in general use for one half to three fourths of a century. In the case of mammals, many of the early genera were not thus "validated" till many years later than those of birds. To take genera from the date of "validation" would obviously establish a new source of trouble in relation to priority of names.

It is now the custom of a large number of nomenclators to make a distinction between a nomen nudum and a name that is for any reason unidentifiable;[4] the former can be employed by a later author, from whom it must date; the latter can not be again used, the attempt at a diagnosis, however brief or inadequate, precluding its subsequent employment. Hence a name founded on a diagnosis, and subsequently validated, can not be taken from the validating author, but must date from the founder, if this rule be followed. Furthermore, to call a genus a nomen nudum when based on a diagnosis is a misuse of language, and entirely contrary to usage.

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THE ORIGIN OF THE MOON

In his inaugural lecture delivered in Columbia University, November 3, 1908,[1] Dr. Albrecht F. K. Penck, the Kaiser Wilhelm "Umtausch" Professor, spoke in part as follows concerning the geographical and geological similarities between the eastern coast of North America and the western coast of Europe:

These similarities between Europe and peninsular North America are not merely superficial ones. *In a very remarkable way, these two sides of the Atlantic repeat the same structural features;* there is an astonishing symmetry, as Eduard Suess has shown so clearly. The northeast of Canada and Labrador on one side, and Scandinavia with Finland, the region of Feno-Scandia, on the other, are both composed of the oldest rocks we know of. These have a very complicated structure, being intruded with many eruptive rocks, and in a secondary way only, the surface features of the above regions are dependent on their structure. Both regions had already been leveled down before Cambrian times, and they sink gently down under a cover of horizontal Paleozoic strata. Both were called by Suess shields. The resemblance between these shields is the more conspicuous because both were covered during the last ice age by a glaciation which molded their surface in a similar way. In Sweden and Finland we find the same rounded

[4] See Revised A. O. U. Code, Canon XXXIV., and the explanatory "remarks."

[1] For the whole lecture see Science, February 26, 1909.

glaciated surface, the same numerous lakes, as in Canada, both regions of the earth claiming to be the land of the many thousand lakes. At the border of both regions the horizontal Paleozoic strata begin with an escarpment which is pronouncedly developed south of Lake Erie and south of the Gulf of Finland, called here the "glint," and we shall keep this expression to designate similar escarpments. These strata continue far into the interior of Eurasia, and they do the same in North America.

And again:

It is very interesting to see how the Appalachian region ends at Newfoundland, forming the projecting eastern corner of North America, and just opposite in south Ireland, in south Wales, in Cornwall and in Brittany the belt of the old Hercynian Mountains of Europe begins. One seems to be the continuation of the other, and such an excellent geologist as Marcel Bertrand maintained that *we have here to deal with the two ends of one very extensive belt of mountains which extended through the North Atlantic Ocean. But we must not forget that the missing link between both ends of these supposed mountain chains is longer than their known extent.* (The italics are mine.)

It seems to me that these and other parts of his lecture throw an interesting light on the theory of the moon's terrestrial origin. In brief, the theory is that when the earth had cooled from its molten condition sufficiently to have a crust of solidified matter something like thirty miles thick over its entire surface, it was revolving so rapidly that gravitational attraction and centrifugal force practically balanced each other. For some reason, perhaps some vast and sudden cataclysm, a large portion of this crust was thrown off the earth, and by tidal action was forced gradually outward in a spiral path. In order to form the moon, a mass of this crust about thirty miles thick and of area nearly equal to the combined areas of the present oceans on the earth must have been thrown off. It is supposed that this immense amount of crust was largely taken from the present basin of the Pacific, and that the remaining parts of the earth's crust, while it still floated on a liquid interior, split along an irregular line into two pieces which floated apart, and the gap between these two parts was later filled with the waters of the Atlantic. Many reasons are advanced for the probability of this theory—the fact that the two coasts of the Atlantic have the same contour, the identity between the density of the moon and that of the earth-crust, etc. Professor Penck is evidently [not] considering this theory at all in his lecture, and yet it seems that what he, approaching the problem from a geographical standpoint, has to say about it, lends a greater probability to the theory. As he says, the Appalachian region ends at Newfoundland, about the latitude of 50° north, and just opposite, in Great Britain, on the same latitude, the same region seems to continue. If the theory of the terrestrial origin of the moon, outlined above, be accepted, we can explain this phenomenon much more simply than did Bertrand, and need not suppose the range to extend across the bed of the Atlantic at all.

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SCIENTIFIC BOOKS

Scientific Ideas of To-day. A popular account of the nature of matter, electricity, light, heat, etc., in non-technical language. By CHARLES R. GIBSON. Pp. 344; illustrated. Philadelphia, J. B. Lippincott Company. 1909.

This book is one which would justify a favorable estimate from almost any other point of view than that which the present reviewer chooses to take. Thus, William E. Rolston gives a favorable estimate of the book in his review of it in *Nature;* indeed many sections of the book are such as to demand a favorable estimate from any point of view. For example, the description in terms of the electron theory of what takes place when glass is rubbed with silk or when zinc is dissolved in a voltaic cell (see pages 73–79) is as clear as any one could wish to have it; and in many cases the "scientific ideas of to-day" which are elaborated in the book are applied at once to the analysis of actual phenomena. But some weeks after looking over the book, I came upon what to me seems to be a very significant paper by Professor William James, "On a

Very Prevalent Abuse of Abstraction,"[1] which happens to express precisely what I wish to say concerning the book and the kind of popular scientific writing which it represents. Professor James says that "to be helped to anticipate consequences is always a gain, and such being the help that abstract concepts give us, it is obvious that their use is fulfilled only when we get back again into concrete particulars by their means." By far the greater portion of the book under review fails to meet this condition of utility, and on the whole the book can not be looked upon as a preliminary step towards a subsequent realization of this idea of utility.

One phase of the author's point of view may be seen in the following quotations: "Water is nothing more or less than a chemical combination of two gases" (page 25); "Chemical affinity is nothing more or less than electrical attraction between different atoms" (page 29); "An electron is nothing more or less than electric charge in motion" (page 51); "An electric current is nothing more or less than an electron current" (page 75); "Light is simply waves in the ether" (page 158); "It must be clearly understood that all atoms of matter are made up of a number of electrons revolving in regular orbits, and that we can not in any way disturb these arrangements" (page 157). As if one could be placed under obligations to clearly understand any physical fact in terms of an extremely vague hypothesis!

Professor James gives the name "vicious abstractionism" to this mode of using concepts. He says:

> We can see a concrete situation by singling out some salient or important feature in it, and classifying it under that; then, instead of adding to its previous characters all the positive consequences which the new way of conceiving it may bring, we proceed to use our concept privatively; we reduce the originally rich phenomenon to the naked suggestions of that name abstractly taken, treating it as a case of "nothing but" that concept, and acting as if all the other characters from out of which the concept is abstracted were expunged. Abstraction functioning in this way becomes a means of arrest far more than a means of advance in thought.

[1] *Popular Science Monthly*, May, 1909.

The viciously privative employment of abstract characters seems to be the greatest infirmity of the average mind in scientific work, and books like this of Mr. Gibson's stand for the extension to a wide circle of readers of a hopelessly sterile philosophical by-product of the modern physical sciences.

The authors of such books as "Scientific Ideas of To-day" stand before us, indeed, chiefly in the rôle of teachers; but the teaching of the physical sciences is to a very great extent a matter of exacting constraint, and it can not be accomplished in a manner which is pleasant and popular.

> Da wird der Geist Euch wohl dressiert
> In spanische Stiefeln eingeschnürt.

The teaching of physical sciences is indeed a compelling insistence upon precise ideas, a forcible "making up" of a student's mind, as it were; for, as Whewell says, nothing is so essential in the acquirement of exact and solid knowledge as the possession of precise ideas, not, indeed, that a perfect precision is necessary as a means of retaining knowledge, but that nothing else so effectually opens the mind for the perception even of the simplest evidences of a subject.

In speaking of the constraint that is involved in genuine science teaching I do not refer to the necessity of overcoming indifference, but to a condition which is real in the face of any amount and any quality of enthusiasm. Every one is of course familiar with the life history of a butterfly, how it lives first as a caterpillar and then undergoes a complete transformation into a winged insect. It is of course evident that the bodily organs of the caterpillar are not at all suited to the needs of a butterfly, the very food (of those species which take food) being entirely different. As a matter of fact, almost every portion of the bodily structure of the butterfly is dissolved into a formless pulp at the beginning of the transformation, and the organization of a flying insect then grows out from a central nucleus very much as a chicken grows in the food-stuff of an egg. So it is in the development of a scientifically trained mind. In early-

childhood, if the individual has been favored by fortune, he exercises and develops more or less extensively the primitive instincts and modes of the race in a free out-door life, and the result is so much mind-stuff to be dissolved and transformed with more or less coercion and under more or less constraint into a mind of the twentieth-century type. The period during which a young man is receiving his scientific and professional training is indeed analogous in many respects to the period of complete reorganization of bodily structure, and in the other we have a reorganization no less complete of mental structure; in the one the reorganization is wholly dependent upon and determined by internal energies, but in the other the reorganization is largely dependent upon and determined by external constraint.

It is a remarkable thing this changing of men into bees and butterflies! and the operation is indeed severe. But perhaps the most remarkable thing about it is that it is elective in particular, but apparently in our day a dire necessity in general, somewhat like the curious transformation of the axolotl, which lives always and reproduces his kind as a tadpole unless a stress of dry weather annihilates his watery world when he lops off his tasseled gills, develops a pair of lungs and embarks on a new mode of life on land.

A severe operation! And usually for the individual a change, like that of the axolotl, from a fluid world to a rigid one! I remember as a boy a sharp contest in my own mind between an extremely vivid sense of things physical and the constraining function of precise ideas. This contest is perennial, but it is not by any means a one-sided contest between mere crudity and refinement, for refinement ignores many things. Indeed precise ideas not only help to form our sense of the world in which we live, but they tend to inhibit sense as well, and a world in which their rule is unchallenged becomes indeed a dry and rigid world.

Every student should realize two things in connection with his science study; the first is that the study of the physical sciences is exacting beyond all compromise, involving as it does a degree of coercion and constraint which it is beyond the power of any teacher greatly to mitigate; and the second is that the completest science stands abashed before the infinitely complicated and fluid array of phenomena of the material world, except only in the assurance which its method gives. And both of these things are obscured by books like "Scientific Ideas of To-day," books that know nothing of exacting constraint nor ever stand abashed. The attempt to set forth in an easily plausible style the conceptual structure of modern physical science is one of the most troublesome perversions with which one has to deal in the attempt to contribute towards the solution of what is to be perhaps the greatest problem of the twentieth century, namely, the making available to all men of the simpler phases of the logical structure of the sciences in order to give to all men some measure of that clear insight into nature which contributes so greatly to the ordering of one's daily life.

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Normentafel zur Entwicklungsgeschichte des Menschen. By FRANZ KEIBEL and CURT ELZE. 4to, 314 pp., 6 pls., and numerous text figs. Jena, Gustav Fischer. 1908.

This eighth volume in Professor Keibel's series of "Normentafeln" is much larger than any of its predecessors, thus reflecting the special interest which mankind takes in human embryology. Like the earlier numbers it consists essentially of a tabular description of embryos, with plates showing their external form, and a classified bibliography. The titles of papers relating to human embryology occupy 150 quarto pages, and yet, of the publications dealing with malformations, only the more comprehensive have been included. The bibliography is so thorough and useful that it renders this "Normentafel" indispensable to every student of vertebrate embryology. The plates are excellent, and show embryos from 1.17 to 24 mm. in length, seen in several positions. The text figures include numerous single sections, and several partial reconstructions of the embryos described. A

complete series of graphic reconstructions would seem to justify the great amount of labor which it requires, and, at the reviewer's suggestion, Mr. R. E. Scammon is preparing such a series for the "Normentafel" of *Squalus acanthias*. In the Harvard Laboratory some progress has been made toward such a series for the pig. This plan has been partly carried out in the "Normentafel" for man, thus adding materially to its value. The text figures accompany the brief descriptions of the various embryos, which precede the tables.

In addition to the descriptions, tables, plates and bibliography, there are three general discussions of great interest. The first (pp. 7–14) is a critical account of the youngest known human embryos. There has been something hardly scientific in the attempt to obtain the "youngest yet known"—in the description of specimens "excessivement jeune," and in monographs on fragments and pathological debris. Keibel's review shows that the two pages written by von Spee, included in Peters's monograph of 143 pages dealing with a single specimen, is at present the most illuminating account of the youngest human embryo. A reconstruction of this specimen, made by Keibel, is described briefly. From the study of Peters's, von Spee's and Keibel's youngest specimens it is inferred that the cavities of the human amnion, yolk-sac and extra-embryonic cœlom arise as clefts in solid masses of cells; their development is illustrated in a series of diagrams. An amniotic duct, such as is indicated in Eternod's familiar model, is not found in the younger specimens, and in these there is no neurenteric canal.

The second general chapter (pp. 80–89) includes a comparison of human embryos with those of apes and *Tarsius*. It is found that the youngest stages of man and the apes are very similar, but that they differ materially from *Tarsius* at a corresponding stage. Although the human embryo is very much like that of an orang, "a glance is sufficient to distinguish it from any other well-known form." In this chapter it is stated that the bend in the back of human embryos, such as is seen in the reproductions of the His models found in most laboratories, is abnormal.

The third section (pp. 152–162) is a comparative embryological study of various structures, based upon the preceding numbers of the "Normentafeln." Thus it is stated that the allantois in man and the apes develops very early, before segments have formed. In *Tarsius* also it arises before there are any segments, but later than in man and the apes. It first appears in pigs of four to five pairs of segments, in rabbits of about eleven pairs and in chicks of more than twenty pairs. Similar comparisons are made for the lungs, pancreas, thyreoid gland, etc. A foundation is thus laid for future work in comparative embryology which shall be more accurate and detailed than anything yet realized.

It may be noted that in two human specimens, a fifth pair of pharyngeal pouches was identified, in one case reaching the ectoderm. Fox's recent studies of the pig, cat and rabbit have failed to show a fifth pouch, but Tandler declares that its presence in man is not a morphological speculation—it is an established fact. This question is clearly one which requires further study. In fact the great value of this "Normentafel" is the stimulus and aid which it affords to further research. The need of early human embryos is emphasized. The omission of any account of the muscular and lymphatic systems is conspicuous. But the great progress which has been recently made in human embryology has been compactly recorded. The work is of the utmost practical value, and in a recent discriminating review it has been described as a "masterpiece of scientific effort." It is the only comprehensive account of strictly human embryology which is now available.

FREDERIC T. LEWIS

SPECIAL ARTICLES

NOTICE OF TWO NEW HORIZONS FOR MARINE FOSSILS IN WESTERN PENNSYLVANIA

SINCE the time of the second geological survey of Pennsylvania it has been generally accepted that there are three horizons at which marine fossils may be found in the Conemaugh series of western Pennsylvania. The oldest of these is the Brush Creek limestone, about

100 to 125 feet above the Upper Freeport coal. From 60 to 90 feet above this is the Pine Creek limestone, while the Ames limestone is about 125 feet above the Pine Creek and 300 feet below the Pittsburg coal. Under various names these limestones have been reported from a large area in western Pennsylvania, northern West Virginia and southeastern Ohio. As these limestones are all very thin and are included in a great mass of shales and sandstones of debatable origin, the discovery of two more layers containing marine fossils is of some interest.

The first of the layers is about 50 feet below the base of the Ames limestone on Brighton Road, just west of Wood's Run, Allegheny, Pa. This stratum was noted by the writer in 1907, but as it was found in only one place, it was thought at the time that it might be a disturbed block of the Ames limestone. It was, however, mentioned in a paper just published in the *Annals of the Carnegie Museum*, Volume V., page 174, and its correct stratigraphic position indicated in the diagram on Plate XII. As exposed at the type-locality on Brighton Road, the fossiliferous layer is about three inches thick and contains numerous crinoid stems, *Producti*, and cup-corals. It is a hard clayey limestone, with most of the lime leached out at the outcrop. It outcrops at a number of places within two miles of this locality, but has not yet been traced to any distance. At some of the other outcrops the layer is thicker, the greatest thickness noted being eighteen inches.

In an article on the Conemaugh formation in southern Ohio just published in the *Ohio Naturalist*, Mr. D. Dale Condit describes a thin marine limestone about half-way between the Ames and the Upper Cambridge limestones. This limestone occupies the same stratigraphic position as the one here described, but as they are separated by a very wide area in which neither has been sought, it is too early to attempt to correlate the two.

The credit for the discovery of the second layer with marine fossils belongs largely to the Rev. P. E. Nordgren, of Duquesne, Pa., who found loose blocks of fossiliferous shale along the railroad tracks about two miles west of Duquesne. The writer was able to trace these blocks to their source in a layer of green sandy shale at the top of the Birmingham shale. This layer is about 65 feet above the Ames limestone. In the vicinity of Pittsburg the Birmingham shale is a conspicuous formation in the cliffs which border the rivers. It is from 40 to 50 feet in thickness and the base is about 25 feet above the top of the Ames. At the base of the Birmingham there is always a layer of very thin-bedded black shale, and sometimes a coal which is supposed to represent the Elk Lick. Above this carbonaceous layer are thin-bedded dark shales which contain pinnules and stems of ferns, and numerous *Estherias* and fish-scales. Higher up the shales become lighter colored, often sandy, and are very barren of fossils. The only fossils so far found in these light-colored layers are a few specimens of an *Aviculopecten* like *A. whitei*, a shell which is often found associated with fossil plants. At the top of the Birmingham there is an abrupt change in the color, the upper 8 to 15 feet being a red fissile shale. Just beneath the red shale, or sometimes a few feet above the base of the shale, there is a rather prominent layer of sandy shale which has now been found to contain marine fossils. The fossils are species of *Productus*, *Allorisma* and other pelecypods, and *Tainoceras occidentale*. Fossils have been found in this layer in Riverview Park, Allegheny, below Kennywood Park near Duquesne, at Glassport, at Wilmerding and at East Pittsburg. It is most fossiliferous at the locality discovered by Mr. Nordgren below Kennywood Park, and that should be considered as the type-locality.

In Riverview Park *Aviculopecten* may be found in a layer 25 feet above the layer just described and a further search for fossils may show that the Ames is far from being the last marine deposit in western Pennsylvania.

Percy E. Raymond

Carnegie Museum,
May 7, 1909

NEW FACTS ABOUT BACTERIA OF CALIFORNIA SOILS

The bacteriological study of California soils at this Experiment Station during the past year

marks the beginning of research on the biology of soils of the arid regions. Some of the facts gleaned in these studies present such striking features that it was thought wise to make a brief preliminary report on them in this journal. The facts may be categorically enumerated as follows:

1. Nitrite formation from ammonia compounds formed by the ammonifying bacteria has been found to take place markedly at depths of twelve feet in a soil from Haywards, Cal. Further, in samples gathered under the greatest precautious to avoid contamination, nitrite formation was found to go on actively at a depth of five and one half feet in a soil gathered at Riverside, Cal. Below five and one half feet there was a compact layer of hardpan in which there was little or no bacterial growth and nitrite formation could not, therefore, be expected deeper down in that particular soil. In six other soils collected in different parts of this state nitrite formation was found to depths of six feet or as far down as we had gone for samples.

2. Contrary to expectations *nitrate* formation, unlike nitrite formation, has thus far been noted only down to a depth of two feet. Further experiments, however, will be instituted to ascertain if this holds true for all California soils.

3. A bacteriological examination of a soil from Auburn, kept in a tightly stoppered bottle on the museum shelves for thirty-one years, reveals at least one representative of each of the groups of nitrogen-transforming or nitrogen-assimilating bacteria, except *B. radicicola*. Of these, several species of ammonifiers were found, one species of nitrosomonas (obtained in the motile and also in the zooglœa form) and one spiecies of *Azotobacter*. The latter exhibits marked differences from the other *Azotobacter* species thus far described, both morphologically and physiologically, and it was therefore named *A. hilgardii* in appreciation of the eminent services of Professor E. W. Hilgard to scientific agriculture. Briefly, the organism may be described as a small elliptical cell, which forms no pigment and only a very thin membrane at the surface of mannite solutions. It is non-motile and has a slight nitrogen-fixing power.

4. The species of nitrosomonas found in the old soil mentioned above was found to have spores. This is particularly interesting, since Winogradsky stated in a report of results of his wonderfully thorough experiments on the nitrifiers, that spores were *never* observed.

No *Nitrobacter* species or nitrate organism has as yet been found in the old soil.

The above facts are probably due chiefly to the great perviousness of the soils of the arid region, owing to the very slow formation of clay substances; whereby moisture, air and roots are enabled to penetrate to depths rarely found in the humid regions.

CHAS. B. LIPMAN
LABORATORY OF SOIL BACTERIOLOGY,
UNIVERSITY OF CALIFORNIA,
May 12, 1909

A SCHEME TO REPRESENT TYPE HEREDITY IN MAN

EFFORTS to reconcile Mendel's laws with the prevailing views of blended effects in heredity need not be unavailing, if the two may be considered as phases of the same process acting at different times during the life history of an elementary species.[1]

Heredity represents all the changes of organic life by three factors:

1. *Determinants*, which are in the germ plasm.

2. *Modifiers*, which are all influences through time and space that act on the germ plasm, and

3. *Laws of change*, which are the rules of conduct by which the determinants and the modifiers interact.

These factors are variable when looked at through all space and during all time, but for any elementary species in a given space and for a limited time they are fixed.

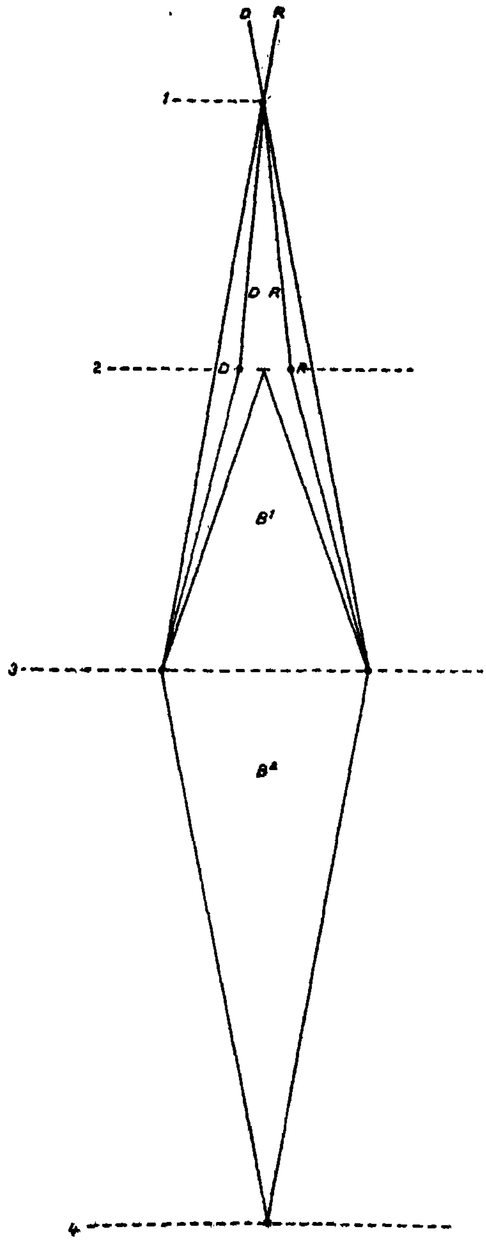
I present herewith a tentative scheme to supplement my theory of heredity.[2]

D and *R* represent homozygotes of an

[1] Spillman, SCIENCE, N. S., Vol. XXVII., 1908, pp. 47–57.

[2] Bean, *Philippine Journal of Science*, 1908.

allelomorphic pair that meet at 1 in sexual union, begin to blend at 2, present the picture of a variable blend at 3, and fuse completely



into a perfect blend at 4. A cross-section of the diagram above line 3 represents the relative number of individuals of the different kinds present at that time. The width of the diagram also indicates the amount of variation at any time. $D=$ homozygous dominants. $R=$ homozygous recessives. $DR=$ heterozygotes. $B^1=$ a variable blend ever increasing in number with each successive generation while D, R and DR decrease to disappear entirely at 3. B^2 represents the continuation of the blend without either of the originals of the allelomorphic pair, but with all shades of intervening characters blending in various ways as influenced by ancestry and by environment, until a homozygote is formed at 4.

From 1 to 2 true Mendelism exists, spurious Mendelism is found from 2 to 3, and from 3 to 4 no Mendelism is present but two tendencies prevail, (*a*) the reversion to type, and (*b*) the tendency to blend.

The three Mendelian (?) conditions may exist at the same time in a single individual, one character exhibiting true Mendelism, another false and a third no Mendelism, or only one condition may be present at one time.

Davenport and Davenport[3] have established true Mendelian heredity for eye color in man; Bateson[4] has designated many conditions in man which indicate spurious Mendelism; and Boas[5] has suggested the two hereditary tendencies above mentioned, when broad-headed and long-headed, or wide-faced and long-faced individuals are united in marriage.

My records of Negroes, of white students, and of the Filipinos suggest that composite types (elementary species?) of men when crossed with opposite types follow the laws of Mendel for not many generations, then begin to blend, and eventually fulfill the requirements of my scheme delineated above. At present all mixed races are probably in a condition of spurious Mendelism or no Mendelism. Among the Negroes in America the Hottentot is rarely seen, the Kaffir is often encountered, and the Guinea Coast Negro is abundant, but the majority of the Negro population represents a variable blend of different Negro types, and a large number of mixed

[3] SCIENCE, N. S., Vol. XXVI., 1908, p. 589.

[4] *Brain*, 1906.

[5] *American Anthropologist*, 1903, 1907.

bloods. Among 1,000 students at Ann Arbor, I observed a few of each of the types of Europe such as the Iberian, Northern, Alpine, Celt, Littoral and Adriatic, but the majority of the students observed were variable blends, and the pure types were not exactly like the prehistoric types of Europe from which they were probably derived, although similar to them in many ways. During the past year my anthropometric investigations have included the Filipinos of many provinces, but especially the Igorots. Here as elsewhere pure types are rare and blends are plentiful. Three primary types (each represented by 8 or 9 individuals selected from 104 Igorots) are found among the Igorots. None of these are pure, however, but one type resembles the Negrito, another resembles one of the prehistoric types of Europe, while the third is unlike either of the others, but not a blend of the two. The majority of the Igorots represent a variable blend, and they have been so long isolated that a condition of no Mendelism has been reached. There is conclusive evidence of the persistence of type, yet the tendency to blend is emphatic.

ROBERT BENNETT BEAN
PHILIPPINE MEDICAL SCHOOL,
MANILA, P. I.

A NEW EDIBLE SPECIES OF AMANITA

DURING the autumn of 1908 I received specimens and sketches of an interesting species of *Amanita* which grows in the mountain forests of California. The specimens were collected and communicated by Mrs. Virginia Garland Ballen, of Brookdale, Santa Cruz County, Cal. The sketches were accompanied by careful notes which Mrs. Ballen had made from her studies and observations. While the plant shows certain points of relationship to *Amanita cæsarea*, especially to the robust European form, Mrs. Ballen had recognized that it was different from the American form of *A. cæsarea*, which is more slender, and in fact it proves to differ in several ways from that species. The plant is edible and often very large, so that a single one is sufficient for a meal. Pending a fuller illustrated account, a brief description is given here.

Amanita calyptroderma Atkinson and Ballen n. sp. Plants 10–15 cm. high, pileus 10–22 cm. broad, stem 2–4 cm. stout. Pileus maize yellow to chrome yellow; gills white, then pale maize yellow to cream color; annulus and stem pale maize yellow to cream color. Pileus stout, extreme margin striate, the central and larger portion covered with the closely adherent white calyptra of the volva; in age of the larger plants this calyptra sometimes cracking into areas. Gills adnexed. Spores oval to elliptical, $8–12 \times 7–8\ \mu$. Annulus very thin, membranaceous, superior, evanescent. Stem hollow with loose cottony threads. Volva white, thick, circumscissile, in dehiscence, the upper portion remaining as a thick skin over the central portion of the pileus; limb very prominent, forming a broad cup- or saucer-shaped structure from which the stem of old plants often separates readily.

GEO. F. ATKINSON

THE AMERICAN ASSOCIATION OF MUSEUMS

THE fourth annual meeting of the American Association of Museums was held in Philadelphia, May 11–13, President W. J. Holland, director of the Carnegie Museum in Pittsburgh, presiding. The following papers were read:

"Cooperation in Scientific and Educational Work between Museums," by President William J. Holland.

"Cooperation among College Museums," by Dr. Daniel S. Martin.

"Cooperation between Museums in Expert Work," by Dr. Edwin A. Barber. (Read by title only.)

"The New Staten Island Museum and its Work," by Mr. Charles Louis Pollard.

"The Insect Pests of Museums," by Mr. C. T. Brues. (Read by title only.)

"Invertebrate Models and Exhibition Groups," by Mr. Roy W. Miner. (Illustrated.)

"The Children's Museum, its Methods of Work and its Results," by Miss Anna Billings Gallup. (Illustrated.)

"The Use of Unkerheimer's Solution for Preservation of Natural Foliage," by Mr. Adolphe B. Covert. (Illustrated.)

"The Darwin Exhibit at the American Museum of Natural History," by Mr. Roy W. Miner. (Read by title only.)

"The British Guiana Expedition of Indiana University and the Carnegie Museum," by Dr. C. H. Eigenmann. (Illustrated.)

"A New Museum Case," by Dr. Hermon C. Bumpus.

"The Educational Work of the Buffalo Society of Natural Sciences," by Mr. Henry R. Howland.

"Suggestions for an Educational Exhibit of the Mollusca," by Mr. Frank C. Baker.

"Present Educational Work of the Philadelphia Museums," by Mr. Chas. R. Toothaker.

"What shall we do with our Skeletons and our Fossils?" by Mr. Henry L. Ward. (Read by title only.)

"The History of Commerce in Museums," by Mr. W. H. Schoff.

"Photographic Enlarging Methods," by Mr. Fred. D. Maisch.

"The Adaptation of a Library to a Commercial and Economic Museum," by Mr. John J. Macfarlane.

"Some of the Most Recent Museum Instruments and Appliances," by Dr. M. J. Greenman.

"The Planning and Fitting of Exhibition Rooms, Especially Picture Galleries," by Mr. Wm. M. R. French.

"Art Museums and the Conservation of Monuments," by Mr. Benjamin Ives Gilman.

"The Desirable Projection of Art Museums as suggested by the Desirable Classification of Art Libraries," by Mr. William H. Goodyear.

"The Training of Curators," by Mrs. Cornelius Stevenson.

"Problems of Modernizing an Old Museum," by Mr. Witmer Stone.

"Exhibition Cases without Shelves," by Mr. Frank C. Baker.

"A Device for exhibiting Fadable Minerals," by Dr. Oliver C. Farrington.

"The Uses of a Collection of Historical Coins," by Dr. T. L. Comparette.

"Popular *versus* Scientific Arrangement of Museum Exhibits," by Dr. James E. Talmage.

"Special Work of a State Museum," by Dr. A. R. Crook.

"Progress of the Ohio Archeological Atlas," by Professor William C. Mills.

These papers will appear in full in the annual volume of proceedings, to be published by the secretary during the summer.

The following officers were elected by the association:

President—Frederic A. Lucas, curator-in-chief of the Museums of the Brooklyn Institute of Arts and Sciences.

First Vice-president—Frederick J. V. Skiff, director of the Field Museum of Natural History, Chicago.

Second Vice-president—Edward S. Morse, director of the Peabody Museum, Salem, Mass.

Secretary—Paul M. Rea, director of the Charleston Museum, Charleston, S. C.

Treasurer—William P. Wilson, director of the Philadelphia Museums, Philadelphia.

Councilors (to serve for three years)—James E. Talmage, director of the Deseret Museum, Salt Lake City, Utah; William J. Holland, director of the Carnegie Museum, Pittsburgh.

The fifth annual meeting will be held in Buffalo in 1910.

The association is preparing "A Directory of Museums of Art, History and Science in North and South America," and all museums which have not received circulars requesting information for incorporation in this work are urged to communicate at once with the secretary.

PAUL M. REA,
Secretary

THE CHARLESTON MUSEUM,
CHARLESTON, S. C.

SOCIETIES AND ACADEMIES

THE GEOLOGICAL SOCIETY OF WASHINGTON

AT the 215th meeting of the society, held at the Cosmos Club, on Wednesday evening, February 24, 1909, Mr. David White presented an informal communication on the "Occurrence of Resin in Paleozoic Coals," and exhibited specimens of such fossil resins from the Coal Measures of Iowa, Illinois and Indiana. Amber and other fossil resins occur mostly in Mesozoic and Tertiary coals that have not been much altered, but in coals that have suffered regional metamorphism they are as a rule absent. Where devolatilization has advanced so far that the percentage of fixed carbon is 65 or more they are seldom found.

Regular Program

Correlation of the Rocks of the Boston Region: LAURENCE LAFORGE.

After a brief résumé of the development of the current ideas on the subject, the following outline grouping of the various rocks was described.

There are two series of sediments, Cambrian and Carboniferous. For the fossiliferous beds of lower Cambrian age the name Weymouth formation has been proposed, while the Braintree slate contains a

middle Cambrian fauna, and there is a non-fossiliferous group of quartzites, schists and hornfels, which may be of any age from lower Cambrian to Ordovician. The Carboniferous sediments comprise the so-called Roxbury conglomerate and Cambridge slate.

About forty varieties of igneous rocks are separated into the following groups on the basis of consanguinity, association and structural relations: (1) a "gabbroic" group, including gabbro, basalt, diorite, amphibolite, etc., of presumably Ordovician age, and represented in the diorite complex of Swampscott, etc.; (2) a "tonalitic" group, comprising granite, tonalite and diorite, probably post-Ordovician and pre-Carboniferous, and represented by the granites of Saugus and Dedham, etc.; (3) a "felsitic" group, a complex of felsites, granophyres, tuffs and breccias, of early Carboniferous age, and covering several large areas; (4) a "granitic" group, including granite, quartz porphyry, nordmarkite, etc., represented by the granites of Quincy and Peabody, etc., of Carboniferous age and possibly contemporaneous with the "felsitic" group; (5) a "basaltic" group, represented by the "Brighton amygdaloid," of Carboniferous age, and (6) a "diabasic" group, comprising hundreds of dikes of Triassic age. There are also some pre-Triassic diabases, of as yet uncertain age.

Fluidal Gneiss and Contemporary Pegmatites: Whitman Cross.

In the Needles Mountain pre-Cambrian area in southwestern Colorado there are several granitic batholiths. One of these, called the Twilight granite mass, is intruded in most intricate fashion in steeply upturned Archean amphibole schists.

Both gneissic and schistose textures are exhibited in the intrusive granite. The former is a fluidal texture originating during the consolidation of the granite. Such textures curve in and out among amphibole schist fragments, the sharp angles of which are notable. Where a secondary schistose texture occurs the amphibole schist and granite are both crushed and sheared and it is difficult to determine in certain localities which is the intrusive rock.

Pegmatite occurs as a phase of the granite in arms penetrating amphibole schist or in relatively small dikes connecting larger gneissose bodies. The transition of the pegmatite into gneissoid granite or granular rock and the absence of pegmatitic dikes cutting the latter show that the pegmatite is practically contemporaneous with the granite. None of these pegmatite masses is more than a few inches wide and the minerals are those of the biotite granite.

Pleistocene Geology of the Leadville Quadrangle, Colorado: S. R. Capps.

The work was commenced in 1903 with E. K. Leffingwell, and completed the following summer with the assistance of J. M. Hill and C. A. Kirtley. Of the 950 square miles of the quadrangle, more than 350 square miles have been glaciated. In this area 36 ancient valley glaciers were studied and mapped. Moraines of two distinct epochs of glaciation, one much older than the other, were found. The ice of the earlier epoch covered approximately the same areas as that of the later one.

The great terraces near Leadville, which have hitherto been referred to as lake beds, are probably remnants of compound alluvial fans, deposited as outwash from the older glaciers. This conclusion is based upon the imperfect stratification of the materials, their lack of lake bed structures, the absence of shore lines, and upon the similarity in structure to present alluvial fans. The terraces also show the same amount of weathering as the older moraines, and the topographic relation between the terraces and these moraines is significant. Lower terraces were found which bear similar relations to the moraines left by the last glaciers. The courses of the Eagle River above Redcliff, and of the Arkansas River, near Granite, have been altered as the result of obstruction by the glaciers.

François E. Matthes,
Secretary

At the 216th meeting of the society, held at the Cosmos Club on Wednesday evening, March 10, 1909, Mr. Wirt Tassin presented an informal communication on "A Method of Illumination for the Study of Opaque Substances under the Microscope," and showed the apparatus for same in operation.

Mr. F. E. Matthes, on behalf of Mr. R. H. Chapman, gave a brief communication on the Culinan diamond, and showed glass models of the stone in the rough and of some of the larger gems cut from it.

Regular Program

Primary Scapolite in Igneous Rocks: F. C. Calkins.

In the Philipsburg quadrangle, in western Montana, a thick series of sediments, largely calcareous, is invaded by batholiths of rocks allied

to quartz monzonite. Associated with some of these batholiths as marginal facies, as small stock-like masses, and as dikes cutting both igneous and sedimentary rocks, are rocks of aplitic habit characterized by the presence of lime-soda feldspar usually in excess of alkali feldspar, a diopsidic pyroxene, and abundant titanite. Some contain scapolite; in one instance this mineral formed about 20 per cent. of the rock. In this rock the scapolite encloses all the other minerals and interpenetrates with all but quartz and the minor accessories, so that there is no doubt of its primary character. Chemical analyses of two of the scapolite-bearing rocks show the remarkable combination of rather high SiO_2, low MgO and iron oxides, with high CaO and Na_2O; chlorine is more abundant than in most rocks. It is surmised that these unusual rocks have been formed by the solution of limestone in magmas of aplitic composition containing abundant chlorine. No partial stages of the assimilation have been observed, and it probably took place at great depths.

On the Origin of Peat: CHARLES A. DAVIS.

Peat deposits are formed: (1) in depressions below the ground water level, (2) on poorly drained land areas where the ground water level is near but usually below the surface. Deposits on slopes in regions of high atmospheric humidity and on subsiding coasts are included in (2).

In (1) the peat is formed mainly from aquatic plants, including microscopic algæ, the true aquatic higher plants, and a little drift material from the shores. As the peat approaches the water surface, amphibious plants, particularly sedges, other herbs and shrubs, grow out over it from the shore, and form a partly or wholly floating mat, which, later, is invaded by terrestrial plants, including sedges, grasses, ferns, shrubs, sphagnum moss and trees, in the order given. The time when each type appears depends on the height of the surface of the mat above the average water level. Peat formation may go on until the basin is filled, or its surface covered.

In (2) the plants forming the peat are mainly terrestrial, but the types chiefly contributing are controlled by the average height of the ground water level, and climatic conditions. If the ground water level rises with the peat, the entire deposit may be homogeneous, and formed by the same kind of plants; if it remains fixed, the bed is generally thin and varies from bottom to top; if the water rises periodically, the deposit is heterogeneous, with beds of the same structure repeated at intervals.

Decomposition of vegetable matter into peat is principally due to the activities of organisms, the most important being aerobic, hence the top strata of wet peat beds are usually most thoroughly d composed.

The Landslide at Frank, Alberta: L. D. BURLING.

At 4:10 A.M., April 29, 1903, an amount of rock variously estimated at from 60,000,000 to 100,000,000 tons dropped away from the northeast face of Turtle Mountain, fell through a maximum vertical distance of 3,500 feet, and covered over a square mile of the valley bottom to an average depth of thirty to fifty feet. The slide wiped out the tipple work and buildings of a coal mine at the foot of the mountain, demolished eight houses and a number of smaller shacks and tents, destroyed about two miles of railroad track and killed about seventy people.

Turtle Mountain is an isolated mass situated just south of the Canadian Pacific Railway east of the Continental Divide between British Columbia and Alberta, and towers 3,000 feet above the town of Frank, which lies at its base. The upper part of the mountain is composed of massive upper Paleozoic limestones which dip westward at angles of 20 to 30 degrees. These limestones are thrust over nearly vertical shales and sandstones of Cretaceous age containing a workable coal seam twelve to sixteen feet thick. The strikes of the massive limestones, the thrust plane and the coal beds are very nearly parallel, and for a distance of three quarters of a mile (entirely across the face of the mountain) and for a vertical height of 300 to 400 feet, the entire coal bed had been either loosened or completely withdrawn.

The slide affected only the limestones above the thrust plane. The horizontal distance between the present crest of the mountain and the toe of the slide is nearly two miles, the maximum vertical difference 3,000 feet and the vertical distance between the crest and the toe 2,525 feet. The slope from the crest of the mountain to the lake at its foot is 32 degrees, the first thousand feet having a slope of about 65 degrees. From a width of 2,000 feet at the crest the talus has a width of nearly a mile at the lake, and with minor variations this width is continued to the hills opposite, a mile away.

Whatever may have been the immediate cause of the disaster—the period was one of frequent and marked alternate freeze and thaw, and seventeen men were at work in the coal mine at the time—cracks had been noticed on the back slope

of the former precipitous peak and the slide may have been brought about by some, if not most, of the following contributory causes: (1) the massive limestones forming the upper two thirds of the mountain had been thrust out over the underlying softer shales and sandstones, and therefore may have been in a state of more or less unstable equilibrium; (2) a considerable layer at the base of the massive limestones had been brecciated by the thrust faulting and had thus lost its homogeneity and competency; (3) the limestones forming the upper part of the mountain were very massive and thus more liable to accumulate strain and to give way in a body than would have been the case with weaker rocks; and (4) the opening up of so thick a coal seam, to such a height and for so long a distance in a direction perpendicular to the dip of the massive overlying beds, in rocks incompetent to withstand the pressure thus induced, created strains in the massive rocks from which the support had been removed.

PHILIP S. SMITH,
Secretary

AT the 217th meeting of the society, held at the Cosmos Club on Wednesday evening, March 24, 1909, under informal communications, Dr. J. W. Spencer presented briefly some notes on the "Recent Draining of Niagara Falls."

Regular Program

The Composition of Stony Meteorites: GEO. P. MERRILL.

The average of a large number of analyses of stony meteorites shows close agreement, after the elimination of the metallic iron, with terrestrial peridotites. From a magma of this kind no amount of magmatic differentiation could produce a series of rocks as rich in silica, alumina, lime and alkalies as those shown by the averages calculated by Clarke and Washington to be characteristic of the earth's crust. World origin through the segregation of materials of this nature is therefore impossible. At the same time it may be conceived that the relative proportion of the elements which make up the mineral matter in the various bodies wandering in remote space, varies widely. If this is so, the earth to-day, in its course, may be passing through and receiving from space deposits of material representing one and the same original body, but not necessarily resembling, in percentage composition, the materials which reached it during past and earlier stages of the earth's history. In brief, the stony meteorites may be regarded as products of an extremely basic phase of magmatic differentiation from a previously more acid magma.

Chemical Composition as a Criterion in Identifying Metamorphosed Sediments: E. S. BASTIN.

Chemical criteria need seldom be resorted to for the identification of metamorphosed sediments of a highly siliceous or a highly calcareous nature. They are inapplicable for the identification of many of the metamorphic equivalents of the arkoses, greywackes and similar rocks, since these may be almost identical in composition with the igneous rocks from which they have been derived. Chemical criteria are also inapplicable in the recognition of flow gneisses and of injection gneisses. Such criteria are therefore restricted in their usefulness for the most part to the differentiation of metamorphosed equivalents of the argillaceous sediments from metamorphosed plutonic and volcanic rocks.

The available analyses of metamorphosed igneous rocks show that well-developed foliated structures may in many cases be developed without important chemical changes, and it seems probable that in a very large number, if not in most, of the metamorphosed igneous rocks with which the geologist has to deal the chemical changes during metamorphism have not been severe enough to obscure their igneous characters. They are in many instances still igneous rocks in composition, and the chemical criteria for distinguishing them from metamorphosed sediments may be brought out by a comparison of the latter with normal igneous rocks as tabulated in Washington's tables of analyses.

The chemical characteristics of the argillaceous sediments and the changes they undergo during metamorphism may be determined by a comparison of the averages of a large number of analyses of clays, shales, slates and schists. By comparing these sedimentary averages with the igneous rocks as tabulated in Washington's tables of rock analyses, the following chemical characteristics are shown to be suggestive of sedimentary origin.

1. Excess of alumina (Al_2O_3) above the amount necessary to satisfy the ratio of 1 to 1 with which it is normally combined with lime and alkalies in igneous rocks.

2. Excess of magnesia over lime ($MgO > CaO$).

3. Excess of potash over soda ($K_2O > Na_2O$).

4. In some instances, excess of silica (SiO_2) has confirmatory critical value.

The evidence of sedimentary origin is greatly

strengthened when two or more of the relationships outlined above exist.

The general conclusion reached may be stated as follows: Both igneous and sedimentary rocks undergo chemical changes during dynamic metamorphism. Such changes in the sedimentary rocks are of considerable magnitude and their character is fairly well known. In the igneous rocks changes during dynamic metamorphism appear to be of much lesser magnitude and their character is not so well understood. The lesser degree of chemical alteration that they undergo as compared with the sediments makes it possible to distinguish between the two in many instances on chemical grounds.

Copper-bearing Amygdaloids of the White River Region, Alaska: ADOLPH KNOPF.

The copper-bearing rocks of the White River region, Alaska, comprise a stratiform succession of basaltic amygdaloids, porphyritic sheets, tuffs and breccias, several thousand feet thick, and constitute the dominant portion of a formation of Carboniferous age. In places the amygdaloids are highly zeolitic, and the zeolites form from 25 to 50 per cent. of the bulk of the rock. Native copper has been found intergrown with prehnite, calcite and zeolites filling the vacuoles in the ancient lavas. At some localities veinlets of chalcocite and laumontite cut the volcanics; at others there occur drusy veinlets consisting of quartz, chalcocite and a black combustible mineral, which when ignited burns with a smoky yellow flame. Veinlets of spherulitic prehnite intergrown with calcite and flecked with native copper and chalcocite, also traverse the amygdaloids. The association of a carbon mineral with cupriferous zeolitic amygdaloids appears to be a novel feature, and it is believed to afford a satisfactory explanation for the precipitation of the metallic copper from the mineral-bearing solutions.

FRANCOIS E. MATTHES,
Secretary

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 665th meeting was held in the afternoon of April 26, Vice-president Day in the chair.

At this meeting, which was complimentary to the American Physical Society, Professor Dr. Max Planck, of Berlin, addressed the society, by invitation, his subject being "Die Mechanik als Grundlage der Physik."

THE 666th meeting was held on May 8, 1909, Past-president Marvin in the chair. Two papers were read.

The Star List of the American Ephemeris: MILTON UPDEGRAFF, U. S. Naval Observatory.

Professor Updegraff gave an account of the star list of the "American Ephemeris" as contained in the first volume of that publication, which is for the year 1855, and also of the star lists contained in the five other national ephemerides of that date. He gave in detail the features of the star list of the "American Ephemeris" and "Nautical Almanac" as it will appear in the volume for the year 1912. The number of stars is to be 825: 800 ten-day stars, 15 northern circumpolar stars and 10 southern circumpolar stars; all circumpolars having their apparent places given for every day in the year. Provision will be made for convenient computation of the effect of the short terms of the nutation for each of the ephemerides of the ten-day stars. These short terms at their maxima and minima have an effect in declination of about a tenth of a second of arc, and in right ascension of nearly a hundredth of a second of time multiplied by the tangent of the declination, and are sufficiently large to make it necessary to take them into account in the more accurate kinds of astronomical work.

Attention was called to the fact that in the "American Ephemeris" the short terms have been included in the Besselian and independent star numbers since the volume for the year 1882, and this fact makes it desirable that the effect of these terms should also be allowed for in the ten-day ephemerides of the stars, although they can not be included directly, as the variation is so rapid as to render interpolation impossible.

A brief account was also given of the star lists contained in the issues for 1910 of the four other national ephemerides. Attention was called to the fact that in the new star list of the "American Ephemeris" the constants adopted by the Paris Conference of the directors of national ephemerides, held in 1896, have been used instead of the Struve-Peters constants which have hitherto been used in the "American Ephemeris," excepting the volume for the year 1900, in which the conference constants were used.

An account was also given of Professor Newcomb's suggested list of fundamental stars, which is now used as the basis of the star lists of all the national ephemerides excepting the *Berliner Jahrbuch.*

The Solar Parallax from Observations on the Planet Eros: C. W. FREDERICK, U. S. Naval Observatory.

The discovery of the planet Eros in 1898 gave astronomers an opportunity to make a more accurate determination of the solar parallax, as the new asteroid approached nearer the earth than any other heavenly body except the moon. Accordingly a campaign was planned for the winter of 1900–1, nearly fifty observatories taking part in the work of observing the planet. The reduction of the observations made at Washington has recently been completed, and the resulting value of the solar parallax is $\pi = 8''.808$ with a probable error of $\pm 0''.012$. This indicates a value greater than $8''.800$, which is contrary to the expectation of astronomers.

R. L. FARIS,
Secretary

THE AMERICAN CHEMICAL SOCIETY
NEW YORK SECTION

THE last regular meeting of the session of 1908–9 was held on May 14.

The following papers were read:

"The Synthesis of 1, 3, 7, 9 Naphthotetrazines," by A. H. Kroppf.

"Peptic Digestion in Aqueous Solutions of Pure Acid Salts," by R. A. Gortner and A. H. Kroppf.

"The Change in Refractive Index with Temperature," by K. Geo. Falk.

"Investigations on the Relative Value of Several Nitrogenous Materials as a Source of Nitrogen to Crops," E. B. Voorhees and J. G. Lipman.

"The Solubility of Salts in Concentrated Acids," by A. E. Hill and J. P. Simmons.

"Congo Blue—Is it a Free Base or a Salt? Congo White—an Aniline Salt of Congo Blue," by I. W. Fay.

"Soluble and Fusible Resinous Condensation Products of Formaldehyde and Phenol," by L. H. Baekeland.

The Rules for the award of the Nichols medal adopted by the New York Section, June 10, 1904, were amended to read as follows:

Rules for the Award of the Nichols Medal (adopted by the New York Section, June 10, 1904; amended, May 14, 1909).

1. A Nichols medal or medals shall be awarded annually for the best paper presented to the New York Section during the previous season, provided the paper is of sufficient merit. The award may be made to any one, whether a member of the society or not, if the paper is eligible under the following conditions:

(*a*) The paper must embody the results of original research in chemistry, which results shall not have been made public before their presentation to the New York Section.

(*b*) The paper must be presented at a stated meeting of the New York Section between the first day of October and the fifteenth day of June.

(*c*) The paper must be presented in its completed form, unless otherwise specially authorized by the executive committee.

(*d*) Within thirty days after being read before the New York Section, the completed manuscript shall be transmitted to the editor of that one of the society's journals for which the paper seems most appropriate.

2. The jury to determine the best paper among those eligible for the award under the above conditions, shall consist of the editors of the society's publications together with such of the associate editors as they may invite to act with them. The editor of the *Journal of the American Chemical Society* shall be the chairman of this jury. Should the jury thus authorized decline to serve, the executive committee of the New York Section shall designate another jury. The jury shall report their decision to the executive committee of the New York Section, who shall have power to decide whether the paper selected is worthy of the award.

3. The secretary of the New York Section shall send to the editor of the *Journal of the American Chemical Society*, as chairman of the above jury, on or before July 1 of every year, a list of the papers which are eligible under the above conditions, with the request that said jury report to the executive committee of the New York Section by the fifteenth of September next following.

4. In case the paper selected for the award is the work of more than one author, the executive committee may present a medal to every author, the names of all the authors being engraved on each medal.

5. The medal or medals shall be presented at the regular October meeting of the section, or as soon thereafter as may be possible.

6. The executive committee shall have power to decide any question not specifically covered by these rules.

7. Any motion to change or amend these rules must be submitted to the section in writing at least one month before being put to a vote, and notice of the proposed change must be made public at the same time and in the same manner as announcement of the meeting at which the motion is to be put.

C. M. JOYCE,
Secretary

SCIENCE

FRIDAY, JUNE 18, 1909

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MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE PHYSICS TEACHER'S PROBLEM[1]

THAT physical science is constantly rendering most magnificent service to human life was never more dramatically demonstrated than on the occasion of the recent wreck of the steamship *Republic.* That a ship, disabled and hidden in a dense fog, was yet able to summon to its aid another ship a hundred miles away by an inaudible, invisible, yet infallible means of communication, thereby saving many hundred lives, is a feat that would have been pronounced impossible by our grandfathers if not by ourselves but a few years ago. Had Mr. Binns, the operator of the wireless telegraph on the *Republic,* lived near Boston about two hundred and twenty years ago, he would surely have been burned for witchcraft.

So thick and fast have come such contributions of science to our commercial and economic life, that most people now take them as a matter of course. A telephone is at present almost as much of a household necessity as a kitchen stove. The steam engine and the electric motor, since by their aid ten men can do the work of one hundred, are increasing our potential manufacturing population at a rate that must satisfy even President Roosevelt that we are in no immediate danger of dying out as a nation. Musicians are being replaced by arc lights, or by pianolas; and even teachers are being compelled to yield their divine calling to graphophones in the "teaching" of foreign languages. Are we then surprised that this is called a scientific age? Do we wonder that scientists are

[1] Address delivered at the Fourth Annual Conference of the Schools of Vermont with the University of Vermont, March 12, 1909.

deeply fascinated by their work, or that the public stand in awe of it?

Yet in the midst of all this, our glory, we must not fail to pause now and then to recall that story of that greatest of astronomers, Laplace. When he had reduced the cosmos to a set of differential equations, by which he claimed that he could foretell the configuration of the universe at any time if he had given the configuration at some other time, he presented his work to Napoleon. After listening to an exposition by Laplace of the meaning of the work, Napoleon remarked: "But I see no place for God in your system." To which Laplace replied: "Sire, I have no need of such an hypothesis."

Suppose some modern Napoleon should, after examining the present formulations of scientific creed, remark: "But I see no place for human souls in this system"; what could science answer? Much it has surely done for the human body; what has it done—what is it doing for the human soul?

A careful investigation of this question seems to show that the distinctive services of science to the human soul may be resumed in two statements, namely: (1) In developing science through the study of nature, the human mind has been trained in clear thinking—it has learned how to solve problems in such a way as to gain for itself the keen vision of a prophet. (2) The clear-sighted experimental study and the partial solution of the problems of nature have continually stored the mind with images which are definite because drawn from concrete experience, and which may thus serve as the basis for clearer abstract thought.

The first of these statements will probably be accepted at once. We all recognize that the power to foresee what will happen under given conditions is one of the chief benefits derived from scientific thinking; and, therefore, we find no difficulty in appreciating the value of a training in this method of thought. The second statement may not be accepted so readily. Yet it must be clear that such basal concepts as angle, area, number and triangle were derived from experience with and the solving of the problems of nature. The idea means more than this, however. The concrete pictures furnished by the solution of scientific problems are essential to clear thinking in other fields than those of science. It has often been said that if no regularity or order were manifested in nature, no thinking at all would be possible. The clear picture of a sequence and order in nature, yet independent of man's will, is of inestimable moral value. So many of us think that we may steal or lie and yet somehow evade the results. Natural science gives a very definite picture of the impossibility of this. The concrete picture of the sun-centered planetary system has been indispensable in the development of the idea of a God-centered religion. Was not Drummond's book called "Natural Law in the Spiritual World"? Are not most of the similes and metaphors of literature today drawn from the clear images furnished by science?

If the two statements just given set forth the two great contributions of science to the civilized mind of to-day, we are justified in setting them up as expressing the purposes to be attained in the individual by science teaching in the schools. We may thus define the purposes of science teaching to be the following: (1) To train the individual into habits of solving problems scientifically, thereby fostering the prophetic spirit in him. (2) To store his mind with clear pictures of organization, which pictures may be used as the basis of abstract thought.

Having adopted these two purposes as the ideal toward which we are to strive in

our teaching of science, we must ask: What criteria have we for testing the results of the work? How are we able to tell whether we are approaching the attainment of these purposes with our teaching? There are two questions which we may put to ourselves if we wish to test our success in attaining these purposes—one for each purpose. First we must ask: Did the problem arise within and out of the student's own experience so that he has a genuine interest in its solution? Is it in some way vitally connected with his life, so that he has an inner motive for its solution? Unless this condition is met, unless the student has real interest in the work put before him, he will get no real training and discipline from it.

The importance of this point has been made very clear by Professor John Dewey in his paper on "Interest as Related to Will"—a paper which has been justly called a supreme court decision on this matter. Professor Dewey says (page 32):

Just because interest is an outreaching thing, a thing of growth and expansion in the realization of impulse, there can be no conflict between its genuine utilization and the securing of that power and efficiency which mark the trained mind—which constitute real "discipline." Because interests are something that have to be *worked out* in life and not merely indulged in themselves, there is plenty of room for difficulties and obstacles which have to be overcome, and whose overcoming forms "will" and develops the flexible and firm fiber of character. To *realize* an interest means to *do* something, and in the doing resistance is met and must be faced. Only difficulties are now intrinsic; they are significant; their meaning is appreciated because they are felt in their relation to the impulse or habit to whose outworking they are relevant. Moreover, for this reason there is motive to gird up one's self to meet and persistently to deal with the difficulties, instead of getting discouraged at once, or half-consciously resorting to some method of evasion, or having to resort to extraneous motives of hope and fear—motives which, because external, do not train "will," but only lead to dependence upon others.

What a different picture this gives from that drawn by those who think interest means amusement; and who, therefore, drive their students by means of motives of hope or fear through unrelated quantitative experiments with the idea that they are giving them discipline!

The second question that we should ask in test of our work is: Are the concepts with which the student is working clear to him? Is the final picture clear, so that clear thinking on his part has been possible? This question needs no further explanation.

Each teacher must answer the first of these questions for himself; no outside person can possibly answer it for him, nor can it be settled by either examination or inspection from the outside. Speaking for myself, then, I may say that for more than three quarters of every class I have, I must answer it in the negative. The majority of each class is attending and pretending to work because of some secondary motive—a college requirement, a desire for credits with a minimum amount of work, a wish to fill an hour in the program, or something of the sort. Comparatively few are there because of an inner interest that impels to good work; and many who might become interested are repelled by the fact that the course is cut and dried, the experiments set up so as to give the student a minimum of obstacles to overcome and a minimum of thinking to do. The testimony of a large number of my colleagues has led me to the belief that this condition is very general—that there are few, if any, teachers whose class as a whole is working spontaneously from genuine interest as defined above. The added testimony of a large number of high-school principals and college deans, who assist the students in the selection of their courses, has made me believe that a large majority of the students shun science courses whenever possible; not because they

are "hard," but because they offer them no chance of expressing their own inner self in new materials—of molding their environment to their scientific imaginations.

The second of these questions above—that concerning the clearness of the concepts—may be answered, at least superficially, by examinations and inspection; and the answer is an unequivocal "*no.*" I am sure that every teacher of physics will agree with me when I say that an examination paper on which there is no utterly foolish statement is a great rarity. The questions asked in class show the same lack of clearness, as has been very forcibly shown by Mr. H. L. Terry in the *Educational Review,* January, 1909. Has any one found a means of making the students discriminate clearly between force, work and power, for example? Here are some examples of what is meant, taken from some recent prize examination papers submitted in competition for a scholarship at the University of Chicago. The competitors were the best students in neighboring high schools. "According to Archimedes' principle, the buoyant force of the water is equal to the volume of the water displaced." "Work is the amount of force that is spent on a certain object, neglectful of time." "Efficiency of a machine is the amount of power received divided by the amount of force exerted upon it." "By Archimedes' principle a body displaces its own weight in water." "The wave-length of red light is longer because in the aurora red light stands out more than does green light."

The fact that from 60 to 70 per cent. of the candidates in physics fail to pass the written examination of the college entrance board each year is eloquent testimony to the same effect.

As the result of a long and careful study of this subject, I can not myself avoid the conclusion that the teaching of physics is not having even a fair degree of success in attaining the purposes stated above. Any one who accepts these purposes as his ideal, must, I believe, concur in this opinion. That others may have other ideals and purposes in teaching physics, has been abundantly shown by the work of the physics commission. In Circular III.[1] we find that 130 teachers suggested 28 different purposes of teaching physics; some suggesting more than one, but not more than 30 agreeing on any one. Thus some few avow that passing examinations is their purpose: others make "mental discipline" the fundamental aim—meaning thereby the teaching of students to do what they do not want to do because they will have to do so the rest of their lives: thus only may physics become a preparation for grim life. Still others may have the end of teaching the laws and principles of physics; by which is meant bringing the student to the point where he is able to recite and write the statements of these laws, even though he may not be able to show that he possesses clear concepts of the physical quantities related by the laws, or of the relations they describe. Thus he who has other purposes in teaching science may justly believe that physics teaching is satisfactory; but he who accepts as his highest ideal the purposes stated above, must acknowledge that the greater part of physics teaching at the present time fails, to a greater or less extent, to attain those purposes. The teaching of physics is not on that account useless altogether: it is only that it might be a real creative power in education instead of a mere adjunct.

The physics teacher's problem is now before you. It may be stated thus: How shall courses and instruction be modified so as to make the work more nearly approach to the teaching purposes? We teachers

[1] *School Science and Mathematics,* November, 1906.

shall, of course, have to solve this problem by experiment. We have got to learn first of all to apply the methods of our subject to our teaching problem; we must each and all of us preserve a frankly open-minded and questioning attitude toward our work, and be ever ready to experiment and to make changes in our methods when we find them faulty. We must not cease asking ourselves test questions like those given above, and should regard the students as our real materials for investigation.

But the problem before us, as thus far stated, is too general and vague. We must be more specific, and show just where improvement is most needed. Before making the problem more specific, I want to point out that there are two serious obstacles that confront every teacher who wishes to undertake experimental scientific work along this line. One of these obstacles is an administrative one, due to the school system in general; this obstacle is controlled by forces outside the teacher. The other is a psychological obstacle, due to the past habits of the teacher himself; and to the failure on the part of teachers generally to have definite notions of the meanings of words like interest, discipline, qualitative, quantitative, mathematical, abstract, physics, law, principle and so on.

Time forbids that we discuss these obstacles in detail. Yet they must be removed before the physics teachers will be free to attack their real problem effectively. I will merely state specifically what they are and what is being done to remove them. The first obstacle consists in the systems of regulations that exist for the purpose of securing uniformity of work, whether for college entrance or otherwise. They are not aimed at securing uniformity of good teaching—if they were, there would be no complaint. They attempt to secure uniformity of subject matter. To any one who studies the system from the point of view of educational value to the individual student, it can not fail to appear injurious and subversive of the ends it tries to reach, namely, vital study. It makes but little difference whether such systems are maintained by examination, or by accrediting, or by state law. The injury comes from the fact that the subject matter of the course of study is specified in minute detail by some authority outside the school and hence unfamiliar with local conditions, particularly the motives and interests of the particular students concerned. The outside authority may be either a board of regents, a committee of some association or a group of colleges, without in any way lessening the evil effect of seriously hampering the teacher in the use of his own initiative and in his attempts to meet local and individual needs. A certain degree of uniformity is certainly desirable; but a bare outline of the larger phases of the subject suffices for this, and avoids the very grave injury that is sure to result to the students from a long and detailed syllabus enforced by an authority outside of the school.

Perhaps the best statement of the fundamental fallacy of this strife for uniformity is that given by Professor Dewey in the pamphlet mentioned above (page 16), when he says:

> I know of no more demoralizing doctrine—when taken literally—than the assertion of some of the opponents of interest that *after* subject-matter has been selected, *then* the teacher should make it interesting. This combines in itself two thoroughgoing errors. On one side, it makes the selection of subject-matter a matter quite independent of the question of interest—and thus of the child's own native urgencies and needs; and further it reduces method in teaching to more or less external and artificial devices for dressing up the unrelated material so that it will get some hold upon attention. In reality, the principle of "making things interesting" means that subjects shall be selected in relation to the child's present

experience, powers and needs; and that (in case he does not perceive or appreciate this relevancy) the teacher shall present the new material in such a way as to enable the child to appreciate its bearings, its relationships, its necessity for him.

This quotation also makes clear why those who believe in extended and detailed syllabi can think of interest only as synonymous with amusement, so that they strive for a supposed discipline which Professor Dewey shows to be subversive of true discipline as follows:[3]

The absurdity of much of the current conception of discipline is that it supposes (1) that unrelated difficulties, tasks that are only and merely tasks, problems that are made up to be problems, give rise to educative effort, or direction of energy; and (2) that power exists and can be trained at large apart from its application.

This first obstacle of administrative systems was considered at length at the recent meeting (February, 1909) of the Department of Superintendence of the National Educational Association by Superintendents Stratton D. Brooks, of Boston; C. E. Chadsey, of Denver; W. E. Chancellor, of South Norwalk; C. P. Cary, of Wisconsin, and R. J. Aley, of Indiana. There was a striking unanimity in their recognition of the injurious nature of present practises. All made constructive suggestions for improvement, and those who are interested in this matter should read their papers, which will be published soon in the proceedings. You should also read the able papers on this topic by Professor J. M. Coulter in the *School Review* for February, and by Professor F. N. Scott in the same journal for January. The Carnegie Foundation for the Advancement of Teaching is devoting considerable attention to this matter, and several state legislatures are considering bills relative to it.

The second obstacle—that of the lack of understanding among teachers of certain terms—is being rapidly removed by the discussions now being held at meetings of teachers' associations and at conferences like this. I am sure we shall soon come to understand each other better, provided all can recognize that the discussion is a wholly impersonal one, carried on solely in the interests of the coming generations. We may therefore pass on to the more definite specification of the real educational problems that now confront the physics teachers.

The first important problem is that of the preparation of the child for science. There is at the present time practically no science in the elementary schools. In the earlier years of the high schools there is very much less science than there should be. Suitable courses in elementary science must be devised for and presented in the earlier years of the elementary schools, in order to store the child's mind with an adequate supply of concrete experience with the materials of science. In solving this part of their problem, physics teachers will have to cooperate with the nature study and the industrial education movements, since it is through these that the elementary basis will be laid. This is the most important and difficult problem. When it is solved, the nature of the high-school course will in large measure be determined; not, as at present, by what may come after, but by what has gone before. The college courses in turn will have been modified to fit the high-school courses, and not the reverse.

The solution of this problem will require much time and a large amount of scientific experiment. In the meantime, we can do much to make the present one-year course in the high school much more efficient than it is in yielding clear and definite concepts and in training in clear thinking. How may this be done?

The chief reason for the present failure

[3] *L. c.*, p. 32.

of the physics course to train in scientific thinking seems to me to lie in the fact that the method of presentation used is thoroughly unscientific. Abstract and difficult concepts in the form of definitions and laws are thrust upon the student without warning, and before his mind is adequately prepared for them by suitable common sense discussions of his concrete experiences—he does not feel their necessity or see their use.

Illustrations of this failing may be taken from any chapter of any of the texts now in use. Thus, the discussion of light is generally introduced by statements concerning the luminiferous ether; properties of matter are introduced in terms of molecules and atoms; heat is explained as a form of energy before its properties are studied. But the most notorious offenses against the scientific spirit of the student are committed in the name of the absolute system of units; they cluster about that tiny and apparently inoffensive thing, the dyne. Unless a student gets a clear conception of what a dyne is, he is lost; because most of mechanics depends on it, in the present method of presenting the subject. Far be it from me to attempt to belittle the dyne—it is little enough already. Nor would I give the impression that the dyne is unessential for the adult physicist, or that the absolute units are not the most beautiful and useful of all the "absolutes" under which the rationalistic mind has sought to hide its real ignorance of reality. The trouble with the dyne in elementary teaching is that it can not be derived directly from experience. It depends for its definition on a convention that can not be verified by experience. The student can, of course, learn to recite the definition of the dyne, or even to write the formula that expresses this definition; and, by mechanical substitution in this formula, he may be able to solve abstract problems—problems that are made up to be problems, but that can not be realized in practise or related to experience. He can not visualize the dyne, nor form a concrete image of it—an image that is derived directly from experience and that is therefore usable in clear thinking.

To a beginner pushes and pulls are the real forces. He can appreciate their measurement by elastic springs, and their comparison in terms of pounds or grams weight. He can not, as a rule, appreciate the measurement of force in terms of mass-acceleration for three reasons, namely: (1) He has no clear scientific concept of mass and it takes considerable time to acquire it. How many of us teachers would agree on any one attempted definition of mass? (2) He has very imperfect notions of acceleration; and he really can not get a concrete, quantitative picture of this without the calculus. Did not Newton himself invent the calculus before he was able to treat acceleration? (3) In all of his actual experiences with natural phenomena the force balanced by mass-acceleration is small compared with the force balanced by friction and other resistances.

For these reasons it seems to me perfectly clear that the dyne should not be introduced at the beginning of a course in elementary physics. If a second year of work in this subject is given in the high school, the dyne might be introduced then, provided that the first course had been of the right sort; otherwise it must be left for the colleges.

Since the dyne is the actual point of contact—I might appropriately say the mathematical point of contact—between the two opposing pedagogical creeds of physicists, it is very important that we see the point clearly and appreciate its great significance for physics teaching. I, therefore, will adduce some of the arguments that are put forth in favor of retaining the dyne so as

to point out again the psychological fallacy involved. The dyne has been defended in a recent discussion before the Eastern Association of Physics Teachers,[4] as follows:

First it will be noticed that, as the units of the system are logically derived from the fundamental units, logical reasoning on the part of the pupils will be required. Those educators who contend that the chief work of the physics teacher is to entertain and amuse will not accept this as an argument. Others, however, will take delight in the opportunity afforded for rapid-fire drill and review. Question—What is a watt? Answer—A watt is a unit of power and is equal to a joule a second. Q.—What is a joule? A.—A joule is a unit of work and is equal to ten million ergs. Q.—What is an erg? A.—An erg is the C.G.S. unit of work and is the work done by a force of one dyne acting through one centimeter. These questions can be continued until the pupil has not only shown that he knows the definition of the centimeter, the second and the gram mass, but also that he has a knowledge of what work, force, etc., themselves are.

In reply to this let me point out that reasoning with words which have no concrete content is useless and scholastic. A student may jingle along words like watt, joule, erg, dyne; but, without clear concepts of the meanings of these terms, his logical faculties get no more training than if he were arguing how many devils can dance on the point of a needle. As Mr. H. Poincaré has pointed out ("Essay on the General Definitions of Mathematics"):

What has been gained in rigor has been lost in objectivity. It is by withdrawing from reality that this perfect purity has been acquired. Demonstrations are constructed by logic, but inventions are made through intuition. To know how to criticize is good; but to know how to create is better. Logic tells us that on such and such a path we are sure to meet no obstacles; but it does not tell us which path leads to the goal. The faculty that enables us to do this is intuition.

Second: I know of no physics teachers who think the work of the physics teacher is to amuse; unless possibly it be those who keep their students loafing over quantitative experiments from which the difficulties have been removed, by logic or otherwise, and which are therefore incapable of giving "discipline" in the true sense defined above.

Third: The string of questions and answers runs along very smoothly on paper—almost as smoothly as The House that Jack Built: This is the dog, that worried the cat, that killed the rat, that ate the malt, that lay in the house that Jack built. To my thinking, this latter is far richer in thought content to the student than is the string about watts, joules, ergs. Such a string of questions may surely be continued till the student has learned the words that are supposed to define the gram mass, but no amount of questioning of this sort will ever lead him to a scientific concept of mass, or to a "knowledge of what work, force, etc., *themselves are.*" Physicists are agreed that knowledge of this sort is useless, even if it were attainable. Thus Poincaré says ("Science and Hypothesis," page 78):

Even though direct intuition made known to us the real nature of force in itself, it would be insufficient as a foundation for mechanics; it would besides be wholly useless. What is of importance is not to know what force is, but to know how to measure it.

Again (page 73):

When we say force is the cause of motion, we talk metaphysics, and this definition, if one were content with it, would be absolutely sterile. For a definition to be of any use, it must teach us to *measure* force; moreover that suffices; it is not at all necessary that it teach us what force is *in itself*, nor whether it is the cause of the effect of motion.

In like vein William James says:[5]

The term "energy" doesn't even pretend to stand for anything "objective." It is only a way of measuring the surface of phenomena so as to string their changes on a simple formula.

At this same meeting of the Eastern Association of Physics Teachers the present es-

[4] Report of the fifty-second meeting of the E. A. P. T., p. 13.

[5] "Pragmatism," p. 216.

sentially rationalistic system was further defended as follows:

Second—It will be observed that the absolute system enables us to define in a simple manner certain physical quantities which can not otherwise be defined without great circumlocution. For example—an unbalanced force always produces some kind of acceleration. How can force be better defined than by the acceleration which it will produce? This being the case, what better unit of force can be employed than one which will give a unit mass a unit acceleration? $F = ma$ is the simplest possible statement of the measure of a force and one which, if the pupil understands acceleration, will greatly assist him in obtaining some conception of force.

To the first of these statements I will let Professor John Perry, the leader of the reform movement in England, answer:[6]

There is too much hankering after a kind of logical perfection which is impossible in the teaching of the average boy. I am afraid that what seems to you simple is to him complex, and what seems to you complex is to him quite simple. As a result, you have not made his studies as interesting to him as you might, and whatever is uninteresting to him is uneducational.

I may add that clear definitions grow out of experience, and by teaching word definitions that have not been justified in advance by experience, we are but training in the habit of hiding our ignorance of things under high-sounding words.

To the second statement about the simplicity of the definition of force I would remark: "Certainly." But I would place the emphasis where the writer did not intend it, namely, on the clause "If the pupil understands acceleration." I must also add: "and if he has a concrete and scientific concept of mass."

It was in addition urged that by teaching the absolute units the physics teacher has an opportunity to do a real service to the college. It would be a real service to the college if the secondary school teachers would send to the colleges young men and women with clear and definite concepts and with a training in habits of scientific thinking, rather than with memories crammed with words and verbal definitions. That the secondary schools are not doing this real service under the present system of "absolute" teaching, is shown by the fact that 70 per cent. of the candidates in physics fail in the written examination of the college entrance board. And how about the 90 per cent. of the high-school pupils who do not go to college? Are the secondary schools doing a "real service" to them in launching them on life with a fullness of word definitions and an emptiness of definite and useful information concerning the physical world about them?

I can not help wondering how long the absolute physics will be defended on the grounds that it gives "mental discipline," that it pleases the colleges, and that it furnishes data needed by the expert physicist. Even if these claims were true, that defense has been torn to shreds in the battle over Latin; which was claimed to give "mental discipline," to please the colleges, and to furnish data needed by the professional theologian. There is certainly something in physical science for everybody, and it is equally certain that that something is not to be gained from any catechism of questions on watts, joules, ergs, dynes, etc.

Although I am convinced myself, after having tried the experiment, that the elementary physics should not attempt to teach the absolute units, I would not for an instant advocate any system of regulations by which the use of these units was prohibited. There are many able and sincere teachers who honestly believe in their use, and such teachers should not be prevented from using them. On the other hand, those who do not believe in them, who have found by their experiences that it is useless to try to teach them to their pupils, should not be compelled to do so by regulations aimed at securing uniformity and enforced by an

[6] *Mathematical Gazette*, January, 1909, p. 7.

authority outside the school. This is an excellent example of the way in which such regulations effectively block progress by prohibiting the teacher who would study education scientifically from trying experiments, thus dwarfing him as a science teacher by barring him from applying scientific methods to the study of his teaching problem. Until differences of this sort have been settled by experiment, it is irrational and very injurious to the students to make regulations that decide such questions in advance on *a priori* grounds.

This deductive, logical, abstract, defining-without-concept habit in present physics teaching has been inherited direct from Newton. It is a habit of which Professor Perry says:[7]

> I take it that the method of study into which Newton was forced, became, because of Newton, the favorite English mathematical study, and we know that it kept English mathematicians back for a hundred years. In the shape of elementary deductive geometry, it is keeping back every schoolboy now.

What does this mean? You recall that Newton, when he presented some of his optical discoveries to the Royal Society in 1672, was attacked by Hooke and others and drawn into quite a controversy. This was very distasteful to Newton; and so, before presenting his "Principia," he put it into such form that it would be unassailable. Euclid being the model of such necessary reasoning, this was his model. So we find that the "Principia" begins with definitions, axioms, scholia and the other paraphernalia of geometry. But it is very clear that Newton did not reach his definitions in any such way. They gradually developed in his mind as the result of long pondering over the phenomena, the experiments, and the known data of mechanics. Any one of you who has seriously tried to grasp the real meaning of his justly celebrated "laws or axioms of motion," or who has read and pondered over the voluminous literature that has been written about them, can not fail to be impressed with the mighty genius of the man who first formulated them. It was a very great feat of the scientific imagination. And yet we expect the average high-school pupil to repeat that feat in three or four lessons, and to have facility in the solution of abstract problems involving these definitions in less than a year! And this without having given him the full experimental basis for those laws nor having taught him to ponder scientifically so that he can follow the reasoning by which Newton reached his conclusions.

I have already shown that in England this fallacy of logical perfection in elementary physics has been exposed at the hands of Professor Perry. In Germany the same is true. That celebrated commission that has been studying this matter there adopted as one of its theses with regard to physics the following: "In teaching, physics must not be treated as a mathematical science, but as a natural science." The meaning of this is given in the following words:

> The specific value of the teaching of physics for general culture has long been diminished because of the fact that physics is treated primarily as a mathematical science. The chief reason for this is that physics itself has long regarded it as an ideal to present itself in deductive form after the manner of a mathematical system. This is particularly true of the fundamental portion of physics, the mechanics, the construction of which on a few axioms has been regarded as its chief excellence.

I am glad to be able to say that the latest and best of the German elementary texts—that of Poske—does not contain Newton's second law of motion or the absolute system. Professor Poske is editor of the *Journal for Physics Teaching*, a member of the celebrated commission and a teacher of long experience. The book is written for classes that correspond to those

[7] *Mathematical Gazette*, January, 1909, p. 5.

in the second and third years of our high schools. The book has been received with great approbation by the German teachers. Thus although we are ahead of our colleagues across the water in the matter of laboratory equipment, they are, in my opinion, far ahead of us in their knowledge and practise of sound pedagogy.

The essential distinction that I have been endeavoring to make plain between vigor and rigor, between intuition and logic, between concrete and abstract, between relative and absolute, between interest with true discipline and duty with martial rule, has been pointed out for mechanics most clearly by Professor Henri Poincaré in his "Science and Hypothesis,"[8] as follows:

> The principles of mechanics, then, present themselves to us under two different aspects. On the one hand, they are truths founded on experiment and approximately verified so far as concerns almost isolated systems. On the other hand, they are postulates applicable to the totality of the universe and regarded as rigorously true. If these postulates possess a generality and a certainty which are lacking to the experimental verities whence they are drawn, this is because they reduce in the last analysis to a mere convention which we have the right to make, because we are certain beforehand that no experiment can contradict it. This convention, however, is not absolutely arbitrary; it does not spring from our caprice; we adopt it because certain experiments have shown us that it would be convenient. Thus is explained how experiment can make the principles of mechanics, and yet why it can not overturn them.

Hence the particular part of the physics teacher's problem now before us reduces to this: The present system of teaching physics in its elementary stages fails because of its leaning toward rigor, logic, the abstract, the absolute and martial law: the problem is to change the methods of teaching so that vigor, intuition, the concrete, the relative and true discipline shall prevail. One suggestion has already been made as to ways of doing this, namely, *omit the absolute units*. In closing let me throw out two further hints that may assist those who wish to take part in the house-cleaning that is at hand.

[8] English translation, p. 98.

Physics is suffering from lack of unity in the way it is presented to beginners. This may be remedied by a suitable use of the idea of energy. In a recent address at the University of Chicago, Professor G. H. Mead showed that the doctrine of energy plays in physical science the same rôle as does the doctrine of evolution in biological science, since it furnishes concepts and a terminology in which all forms of physical phenomena may be expressed. This terminology and these concepts are particularly useful, because they are derived from the idea of mechanical work, which is one of the most immediate and familiar of the concepts drawn from daily experiences. Most commercial accounts are ultimately balanced in terms of work or energy.

In using the idea of energy as a solvent for unifying and organizing instruction in physics it is not in the least necessary to become an "Energetiker," to deny the existence of everything but energy, and to rule out the imagination and speculation concerning atoms and the like. The idea is one easily grasped by any one, since it is drawn from such universal experience. It can be visualized in the lifting of heavy objects so as to be made very concrete. In my opinion this idea offers a fruitful field for experimentation in the teaching of the elements of physics.

Another fruitful suggestion has been made by Dr. Northrup in the *Journal of the Franklin Institute* for March, 1908. It is to use analogy—not poetic analogy, but strict analogy, such as exists between translatory and rotary motion. This same suggestion was made by Professor Henry Crew at the meeting of the Central Association of Science and Mathematics Teach-

ers last November. It is a suggestion well worth considering.

Has not the time now come when we physics teachers of America should begin experimenting with a purpose of trying to discover the live way of teaching our subject? Are we not now ready to right-about-face, and, instead of trying to make our concrete material abstract and mathematical—instead of trying to teach Newton's absolute time and space and motion—to try to make mathematics and the absolute concrete and real through physics? Shall we not take up the movement now being pushed so successfully by Perry and Armstrong in England, by Klein and Poske in Germany and by the brothers Poincaré in France, and push it along in free and progressive America as well? Surely the time is at hand when the work will be done. Let us therefore all lay hold and help, for better times are coming. C. R. MANN

THE UNIVERSITY OF CHICAGO

ALBERT B. PORTER

ALBERT BROWN PORTER was born at Indianapolis on March 16, 1864, and died at Chicago on April 16, 1909. He was a man of rare endowment, well known to many of the readers of this journal. Since, however, his published researches are comparatively few in number, he was by no means so widely known as his native abilities would ordinarily have made him.

His preparation for college, obtained at the Indianapolis High School, enabled him to enter Stevens Institute at the early age of fifteen. Most of the best training of this precocious lad was, however, obtained in his own home and at the hands of his own father, Albert G. Porter, who was governor of Indiana during the early eighties. From this period dates his acquisition of an almost faultless English style and the beginning of his acquaintance with tools and with the properties of matter. In 1882 he migrated to Purdue University, where he graduated B.S. in 1884.

The Richmond, Ind., High School was fortunate in securing the services of this modest, scholarly and skillful young man during the seven years immediately following his graduation. More than one of his students have testified to his inspiring influence and to the manner in which he helped rapidly to upbuild this institution.

In 1891 he went to Baltimore to pursue, under Rowland, Franklin and Newcomb, the subject of physics to which from earliest boyhood he had been devoted. His fellow students still recall that judicial, alert and independent attitude of mind displayed by him regarding all subjects. Pure science being his ruling passion, the atmosphere of Johns Hopkins University was more congenial to him than any other which he subsequently found.

It was during this period that he was married to Miss Therese Study, whom he had first learned to know as a student in the Richmond High School.

In 1894 he accepted appointment to the chair of physics in the then recently founded Armour Institute. It seems almost needless to add that the department was at once placed upon a high plane. His lectures were beautifully illustrated with many novel experiments and were always set forth in that clear English which can result only from clear thinking. Characteristic of the man is a summer spent with Mr. O. L. Petitdidier in learning the technique of lens grinding, figuring and polishing. After eight years' experience in teaching technical students he resigned in order to take up the manufacture and importation of high-grade physical apparatus, operating under the name of "The Scientific Shop." But we must not imagine that Professor Porter ceased to teach when he entered upon the commercial side of his work. On the contrary, his clientele became larger and more advanced, being composed mainly of instructors in physics from all parts of the country; for, being a man of cultivated curiosity and lucid expression, he had satisfaction not only in gathering information, but also in freely imparting knowledge.

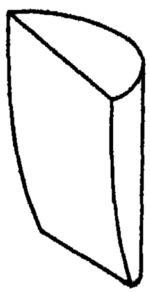
His published papers relate chiefly to the diffraction theory of microscopic vision and

to other optical questions. The various circulars which issued from the The Scientific Shop were always his own, and those who have had the pleasure of reading them will recognize that they are unique in accurate scholarship, in instructiveness and in absolute candor.

No account, however brief, of Mr. Porter's work would be fair, not to say adequate, which did not include some reference to his several large volumes of manuscript "notes," in which he was in the habit of recording new ideas and experimental results. A single citation which will serve to illustrate the cleverness, ingenuity and skill of the man may also be of value to makers of lenses. It is a note, referring to an extension of the benefits of the bifocal lens invented by Benjamin Franklin and having interest as being the last problem upon which he was engaged, and is as follows:

MULTIFOCAL SPECTACLE LENS

Intended to replace the bifocal lens. Would have two advantages (1) "invisibility" in the sense of not being evidently different from a single focus lens and (2) the multifocal property should give clear vision at any distance from (say) 10 inches to infinity.



One face of the lens is curved only in the horizontal plane and the other only in the vertical plane, the radii of each surface growing shorter from top to bottom of the lens in about the same ratio. Thus one surface may be a circular cone and the other a spiral cylinder. The curvatures need not increase uniformly from top to bottom, but the increase should be at the same rate on each side so as not to introduce cylindrical error. Vertical or horizontal astigmatism can be corrected by making one surface of uniformly greater curvature than the other. The surface may be mechanically ground and polished by simple mechanism. Angular astigmatism can possibly be corrected by a superposition of curves, but the surface would not then be "ruled," and the polishing operation might be less certain.

The fault of the lens is that the curvatures and foci are different at top and bottom of the eye. This difference is, however, slight in a large lens, and unless presbyopia is great may not be enough to cause inconvenience.

A. B. P.

August 17, 1907

Under date of January 24, 1909, occurs a two-page note describing in detail a method by which the grinding tools for such a multifocal lens may be made. Then the following:

MULTIFOCAL LENSES

Could be made with spherical surfaces by using a glass varying in density (refractive index) from top to bottom. Such a glass could be made by using a flat melting pot heated from above (to avoid convection currents) in which was placed in very thin layers the varying materials needed to give the varying density. A "guard ring" should be put in the center of the melting pot to avoid convection currents due to unequal heating or cooling around the sides of the pot. The glass should be kept in a molten condition long enough for diffusion to make the density gradient uniform, and the heat should be turned off so slowly that the top always remains hotter than the bottom to avoid convection. A. B. P.

February 5, 1909

Hundreds of suggestive "notes" of this type lead one to wish that it might have been possible for a mind so fertile in resources to have devoted its energies to investigation and pure science, unhampered by the daily routine of teaching or commerce.

HENRY CREW

BANQUET IN HONOR OF PROFESSOR BESSEY

THE Botanical Seminar of the University of Nebraska gave on June 5 an anniversary banquet in honor of Charles Edwin Bessey, to celebrate the twenty-fifth anniversary of his professorship in Nebraska, preceded by fourteen years of professorial service at the Iowa Agricultural College. Dr. Roscoe Pound pre-

sided and first introduced Governor A. C. Shallenberger, who spoke on "Twenty-five Years for the State"; other toasts were as follows: "Forty Years for Botany," by Professor Frederic E. Clements; "His Influence as a Teacher," by Dean Henry B. Ward; "What he has done for the University," by Professor George E. Condra, and "His Influence upon the Layman," by Regent George Coupland. There was then presented to Professor Bessey a set of twenty-four volumes containing the publications of his former students.

The *Sunday State Journal* contains the following editorial appreciation: "The honors paid to Dr. Charles E. Bessey last night by the Botanical seminar of the University of Nebraska were richly deserved. Dr. Bessey has just completed forty years of active service as a teacher of botany—fifteen years at Ames and twenty-five years at Lincoln. When it is remembered that during each one of the forty years he has been in close personal contact with hundreds of young people, has fired them with his enthusiasm as a scientist and has influenced them with his beautiful and simple character—when all this is understood, the value of his career to the public becomes deeply impressive. It has been a source of pride and joy to the university that a man of international fame should decline flattering offers and large salaries to go elsewhere and should devote himself with unflagging zeal to the study of botany here in Nebraska. To the words of appreciation spoken last night the whole state joins in proud and spontaneous applause."

BRITISH ASSOCIATION TRIP TO ALASKA

A NUMBER of members of the British Association having written expressing their desire to go up the coast, arrangements have been made as below. It is desirable for members who wish to take this delightful trip to go before the association meets at Winnipeg, as the weather is often damp and the views obscured by mists during the latter part of September. Some of the members are coming through Asia, and others through Canada and the States before the meeting at Winnipeg, but as the times of arrival of those parties vary, it has been found advisable to encourage them to travel in weekly companies, leaving Victoria at 11 P.M. on Fridays or Vancouver at 11 P.M. on Saturdays between July 16 and August 13 and again on September 10 for each of the undermentioned coast tours by the C. P. R. steamships, which also leave Seattle one day earlier than the above dates at the same through fares.

a. To Prince Rupert, Juneau (Great Gold Mine), Taku and other large glaciers, Skagway, and thence back to Vancouver in nine days, or to Victoria in ten days, traveling nearly 2,000 miles through enchanting scenery along sheltered "fiords." Cost, including meals and berths, $66.

b. Including the above to Skagway, thence over the wonderful scenery of the White Pass Railway and down the Yukon River to Dawson (Klondike) and back. Time, about three weeks. Cost, $160.

Beyond the latter those who have time and desire to go through Alaska round by Nome can do so at reasonable rates. Ordinary travelers' clothing suffices, with thick boots or rubber shoes for climbing. Arrangements are being made to entertain members during their stay at Victoria.

THE CARNEGIE FOUNDATION FOR THE ADVANCEMENT OF TEACHING AND THE GEORGE WASHINGTON UNIVERSITY

THE following letter has been addressed by the president of the Carnegie Foundation for the Advancement of Teaching to the president of the George Washington University:

June 4, 1909.

PRESIDENT CHARLES W. NEEDHAM,
The George Washington University,
Washington, D. C.

Dear Sir:—I am directed by the executive committee of the Carnegie Foundation for the Advancement of Teaching to send to you as president of the George Washington University the following communication.

The George Washington University reported to the Foundation a productive endowment of $219,832.98 as of date August 21, 1907. In the financial statement submitted some time since it reported as of date October 3, 1908, a productive endowment of $123,500.

The rules of the Carnegie Foundation require that an institution, to be entitled to the privileges of the retiring allowance system, must have

a productive endowment of not less than $200,000. This proviso was made because experience has proved that no college can maintain fair educational standards without adequate endowment.

The examination which I have just caused to be made of the George Washington University shows that its announced standards of admission to the various schools are not enforced.

In the college division of the University regular students are admitted with reasonable regard to the stated admission requirements, but of the total enrollment more than one third are special students. The value of the A.B. degree, however, is seriously lowered by the lax administration of the College of Political Sciences and the Division of Education, to which admission is granted with little regard to the published entrance requirements. The Law School announces a four-year high-school education as a prerequisite for admission, but does not enforce it. Similarly in the Medical School the announced requirements for admission have been repeatedly evaded. If the entrance requirements to this school were actually enforced, the enrollment would be so greatly reduced that the department could not continue: a result, I may add, entirely in the interest of medical education, since the District of Columbia and the region about it are over-supplied not only with physicians, but with weak medical schools.

The executive committee feels compelled also to protest against the extraordinary action of the institution in forcibly retiring two professors, both of whom are in the prime of their active teaching, on the ground that the institution needs to save money by the retiring allowance system, but it is entirely contrary to the spirit in which this Foundation was conceived and is a blow at academic dignity and academic freedom.

The committee further calls your attention to the extract from the rules for the admission of institutions, "The Trustees of the Carnegie Foundation for the Advancement of Teaching reserve the right to discontinue the privilege of participation in the system of retiring allowances of the Foundation whenever, in the judgment of the trustees, an institution ceases to conform to the regulations maintained by the trustees. Such withdrawal shall not, however, result in the discontinuance of retiring allowance already granted."

The executive committee, by virtue of the authority conferred upon it under the by-laws, in view of the conditions existing in the George Washington University referred to above, conditions which are entirely out of harmony with the educational ideals for which the Foundation stands, informs you with great regret that the relation of the George Washington University as an accepted institution is terminated with this date.

Very truly yours,
(Signed) HENRY S. PRITCHETT,
President

SCIENTIFIC NOTES AND NEWS

AT its last meeting the Rumford committee of the American Academy of Arts and Sciences voted a grant of $300 to Professor W. W. Campbell, of the Lick Observatory, for the purchase of certain parts of a quartz spectrograph and to Professor M. A. Rosanoff, of Clark University, a grant of $200 in further aid of his research on "The Fractional Distillation of Binary Mixtures."

MR. JOHN J. CARTY, chief engineer of the New York Telephone Company, has received from the Emperor of Japan the decoration of the Order of the Rising Sun in recognition of engineering services rendered to Japan.

THE Bessemer medal of the British Iron and Steel Institute has been presented to M. A. Pourcel.

PROFESSORS YVES DELAGE and M. G. Retzius have been elected foreign members of the Linnean Society.

MR. HORACE DARWIN, F.R.S., has been elected a corresponding member of the Vienna Academy of Sciences.

MR. CLARENCE J. HUMPHREY, assistant in botany in Cornell University, has accepted a position as scientific assistant in forest pathology in the Bureau of Plant Industry.

THE Bowdoin prizes for essays in English for the academic year 1908–9 have been awarded by the faculty of arts and sciences of Harvard University. Three prizes of $200 each were awarded to graduates. The first of these went to C. L. B. Shuddemagen for his essay on "Mechanical Analogues for Electromagnetic Systems." R. C. Mullenix, the second of the graduate prize winners, had as his subject, "The Neurone Theory; Its Development and Its Present Status."

PROFESSOR JOSEPH P. IDDINGS, of the United States Geological Survey, who has been occu-

pied during the past year in the preparation of a work on igneous rocks, the first volume of which has just been published by John Wiley and Sons, has severed his connection with the University of Chicago, and has started on a visit to portions of Japan, China, the Philippines and Java, under the immediate auspices of the Smithsonian Institution of Washington. The purpose of his visit is the study of the volcanic rocks of these regions in order to complete the second volume, or descriptive part, of his book. Publications may be sent to him in care of the Smithsonian Institution in Washington.

Frederick Monsen has gone to the deserts of Chihuahua and Sonora to make ethnological research among the Indians of those parts and to study the physical geography of the region. Late in July, Mr. Monsen will visit Arizona, where three months will be devoted to investigation among the Hopi and Navajo Indians, after which he will endeavor to photograph the Grand Canyon from above by means of kites which he will fly from the rim of the canyon, sending them over 6,000 feet above the surface of the river. Mr. Monsen returns to New York next November.

Mr. William B. Richardson, collecting for the American Museum of Natural History in Nicaragua, announces the shipment of a large collection of birds and mammals made during the last six months at points ranging in altitudes from 700 to 5,000 feet.

Albert A. Giesecke, Ph.D. (Cornell), has been commissioned by the Peruvian government to organize a system of commercial and technical education in Peru, and will leave in a short time for Lima.

Professor Kengo Makino, of the department of electrical engineering, University of Waseda, Tokyo, Japan, is now on his way home *via* Europe after a couple of years spent at Cornell in post-graduate study.

Dr. George Dock, of New Orleans, has sailed for England and the continent. He will attend the International Medical Congress at Buda-Pesth.

Dr. Alfred Dachnowski, of the botanical department of the Ohio State University, is spending the summer in Europe. He will visit the Azores, Italy, Switzerland and Germany, and will make observations on forestry, as practised in those countries.

Recent visitors at the Bureau of Plant Industry of the U. S. Department of Agriculture have been Mr. B. Barlow, of the Ontario Experiment Station; Mr. W. Henry Grant, secretary of the Canton Christian College, Canton, China; Mr. Osborn Ashton, of Cairo, Egypt; Mr. Horace G. Knowles, formerly minister to Roumania; Dr. Arthur Donaldson Smith, Consul at Patras, Greece.

At the University of Pennsylvania the address before Phi Beta Kappa and Sigma Xi will be given by Professor H. C. Richards, of the department of physics.

Professor Charles S. Prosser has given a course of lectures at Ohio State University describing the opportunities for graduate study in geology at some of the leading American universities. Those to which the greatest attention has been given are Johns Hopkins, Princeton, Columbia, Yale, Harvard, Cornell and Chicago.

Mr. John Hays Hammond gave the address at the thirty-fifth annual commencement of the Colorado School of Mines, held on May 28.

The Croonian lecture of the Royal Society was delivered on June 10, by Professor E. A. Schäfer, F.R.S., on "The Functions of the Pituitary Body."

The statue of Lamarck, erected by international subscription, was unveiled in the Jardin des Plantes, Paris, on June 13.

Mr. Charles L. Buckingham, well known as an inventor in the field of telegraphy and as a patent lawyer, died at this home in New York City on May 31, at the age of fifty-seven years.

The death of Dr. J. D. E. Schmeltz, director of the State Museum of Ethnography at Leyden, Holland, is announced. He began his work in the Godefroy Museum in Hamburg, whence he was called to Leyden in 1884 as assistant of Dr. Serrurier. Later on he became director of the museum, and the development of the collections during the last twenty

years has been due to his untiring energies. He was the founder and editor of the "International Archives of Ethnography."

Mr. Thomas Mellard Reade, known for his contributions to geology, has died at his home in Liverpool, at the age of seventy-seven years.

The death is also announced of M. Eugene Grenet, the French electrical engineer.

During the present school year, the council of Phi Lambda Upsilon, a national honorary chemical society, has granted three charters: the first, in Chicago, as the Chicago Alumni Chapter; the second, in New York City, as the Columbia University Chapter, and the third, in Ann Arbor as the University of Michigan Chapter. The society was founded at the University of Illinois in 1899. It has for its fundamental object the promotion and protection of high scholarship and original investigation in all branches of pure and applied chemistry. Active membership is limited to graduate and advanced undergraduate students, except in the case of the student having the highest average grade at the end of the sophomore year. The election of men is based primarily upon their scholastic standing and promise of research ability. Among the honorary members of the society there are: Professors W. A. Noyes, C. F. Chandler, S. L. Bigelow, Louis Kahlenberg, H. C. Sherman, E. D. Campbell, S. W. Parr, M. T. Bogert, H. S. Grindley, S. M. Babcock, R. H. Chittenden, C. G. Hopkins, A. P. Matthews, Drs. L. W. Andrews, A. G. Manns and T. J. Bryan.

At the annual meeting of the Society of Detroit Chemists, held May 28, the following officers were elected: *President,* Frank T. F. Stephenson, chemistry department, Detroit College of Medicine; *Vice-president,* L. D. Vorce, Pennsylvania Salt Manufacturing Company; *Secretary,* H. C. Hamilton, Parke, Davis & Company; *Treasurer,* W. D. Mainwaring, Railway Steel Spring Company. The membership reported is 84. Regular monthly meetings were held through the year, with attendance about 50 per meeting. Preparations have been practically completed for the entertainment of the American Chemical Society in June.

The Biological Club of Oberlin College was organized during the last year, its membership embracing the instructors in the departments of botany, geology, physiology and zoology. Its officers are: *President,* Professor E. B. Branson; *Secretary,* Professor R. A. Budington. During the year the following meetings have been held:

November 25—"Dinichthid Fishes of Ohio, with special reference to a species of Dinichthys in the Oberlin Museum," by Professor E. B. Branson.

December 9—"Internal Secretions," by Professor R. A. Budington.

January 13—Reports by members who attended the Association meetings in Baltimore during the Christmas holidays.

January 27—"Present-day Conceptions as to the Rôle of the Sympathetic Nervous System in Man," by Professor F. E. Leonard.

February 10—"Some Nuclear Phenomena in the Fungi," by Dr. Susan P. Nichols.

February 24—"Some Recent Work on the Protozoa," by Professor M. M. Metcalf.

March 10—"Feeding Experiments with Birds," by Professor Lynds Jones.

March 25—"Maturation Phenomena in Plants and Animals," by Professor F. O. Grover.

April 14—"The Ecological Succession of Birds," by Mr. B. R. Showalter.

April 28—"The Planetesimal Hypothesis," by Professor E. B. Branson.

May 12—"The Phylogeny of the Angiosperms," by Mr. C. B. Wilson.

May 28—"The Static *vs.* the Dynamic and Vitalistic Theories of Evolution," by Professor F. O. Grover.

In connection with the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease, Mr. Burns, the president of the Local Government Board, has, as we learn from *Nature,* authorized the following special researches: (1) a continuation of the investigation into protracted and recurrent infection in enteric fever, by Dr. T. Thomson, in conjunction with Dr. Hedingham; (2) a continuation of the investigation into protracted and recurrent infection in diphtheria, by Dr. T. Thomson and Dr. C. J. Thomas; (3) a continuation of the investigation into flies as carriers of infection, by Dr. Monckton Cope-

man and Professor Nuttall; (4) a continuation of Dr. Andrewes's investigation on the presence of sewage bacteria in sewer air, with the view of ascertaining their number and the distance they can be carried by air currents; also a continuation of Dr. Andrewes's investigation into the part played by changes in bone marrow in the defensive mechanism of the body against infection; (5) a continuation of Dr. Savage's investigations on the bacterial measurement of milk pollution, and on the presence of the Gaertner group of bacilli in prepared meats and allied foods; (6) an investigation into the chemical and physical changes undergone by milk as the result of infection by bacteria, and into the relation of the pancreas to epidemic diarrhœa, by Dr. Schölberg and Mr. Wallis; (7) an investigation of the records of charitable lying-in hospitals as to the nutrition of the mother and other factors influencing the vitality of infants and their progress in the first fourteen days of life, by Dr. Darwall Smith; (8) an investigation into the occurrence and importance, in relation to treatment, of mixed infections in pulmonary tuberculosis, by Dr. Inman; (9) an investigation on the relative importance of certain types of body-cells in defense against the tubercle bacillus, and the effect of tuberculin and other remedial agents on their activities, by Dr. J. Miller.

At the recent conversazione of the Royal Society, Dr. George E. Hale, who has recently been elected a foreign member of the society, exhibited photographs illustrative of work at the Mount Wilson Solar Observatory, as follows: (1) Three photographs of the sun, taken at the Mount Wilson Solar Observatory, April 30, 1908, showing: (*a*) the photosphere, with sun-spots and faculæ; (*b*) the flocculi of calcium vapor; (*c*) the flocculi of hydrogen, at a higher level in the solar atmosphere. The hydrogen photographs, which are made with the spectroheliograph, reveal the existence of cyclonic storms or vortices associated with sun-spots. On the hypothesis that the rapid revolution of electrons in the vortices should produce a magnetic field in sun-spots, a search was made for evidences of the Zeeman effect. Doublets and triplets were found in the spot spectrum, showing all of the polarization phenomena observed by Zeeman in the laboratory, and proving the existence of a magnetic field. The strength of the field (at the level of the iron vapor) ranges from 2,900 to 4,500 C.G.S. units in different spots. (2) Photograph of the sun, taken on Mount Wilson, October 7, 1908, with the red line of hydrogen. The vortices surrounding two large spots in the northern and southern hemispheres appear to rotate in opposite directions. The magnetic fields in these spots were found to be of opposite polarities, as opposite directions of rotation would require. (3) Two transparencies, showing to better advantage the hydrogen vortices in the photographs of April 30 and October 7. (4) Six photographs, showing the mounting of the 60-inch reflector of the Mount Wilson Solar Observatory and the mode of transporting the tube to the summit on a motor-truck. (5) Blue print, showing design for tower telescope, of 150 feet focal length, now under construction for use on Mount Wilson. The hollow members of the outer skeleton tower shield (without touching) the corresponding members of the inner skeleton tower from the wind. The outer tower also carries a dome to protect the cœlostat and other instruments, which are supported at the summit of the inner tower. An image of the sun, 16 inches in diameter, will be formed in a laboratory (not shown) at the base of the tower. The spectrograph for studying this image will have a focal length of 75 feet, and will be mounted in a well beneath the laboratory.

The American Ethnological Society has reprinted Volume III. of its *Transactions*, containing the important paper by William Bartram, on the "Creek and Cherokee Indians," written in 1789; and also the papers by E. G. Squier, on the "Archeology and Ethnology of Nicaragua"; by J. F. Irias, on the "Rio Wanks and the Mosco Indians"; by C. C. Copeland, on a "Choctaw Tradition"; by Berthold Seeman, on "The Aborigines of the Isthmus of Panama"; by Andrea Poey, on the "Antiquities of Cuba." The volume was never issued, almost the whole edition having been burned with the printing establishment. It is claimed that only fifty copies of the original edition were saved. The volume may

be obtained from the American Ethnological Society, Sub-Station 84, New York City.

THE department of railway engineering of the University of Illinois has recently erected a drop testing machine which is identical in design with the standard machine of the Master Car Builders' Association. This apparatus will be used in making impact tests of such materials as car couplers, wheels, axles, etc. It consists essentially of a spring-supported anvil weighing 20,000 pounds (upon which is placed the specimen to be tested), and a hammer weighing 1,640 pounds, which runs in vertical guides rising at either side of the anvil. This hammer may be dropped in these guides from any height up to 50 feet. The addition of this machine to the existing equipment of the College of Engineering of this institution renders it possible to make there tension, compression, bending and impact tests of all materials of construction, on specimens of the full size ordinarily met with in practise. Through the courtesy of Mr. A. W. Gibbs, the Pennsylvania Railroad Company furnished the drawings and loaned its patterns for the construction of this machine. The Cleveland, Cincinnati, Chicago & St. Louis Railroad Company, through its superintendent of motive power, Mr. William Garstang, has donated to the university its services in connection with the work of construction and assembling the machine, which was done at the Urbana shops of this company.

UNIVERSITY AND EDUCATIONAL NEWS

THE state legislature now in session has provided the University of Wisconsin with approximately $2,500,000 for the next two years, beginning July 1. The permanent income of the university is supplied by a tax of two sevenths of a mill on each dollar of assessed valuation of the property of the state. This tax will yield the university approximately $750,000 for the year 1909–10, and over $800,000 for the year 1910–11. The sum of $100,000 annually for the next two years was appropriated in addition to meet the needs of the growth of the institution not covered by the increase in the tax income fund. Besides this $50,000 a year was given for books and apparatus. The legislature also provided $600,000 for buildings to be erected in the order of their greatest need during the next two years. This is a continuation of the building fund of $200,000 a year for a period of three years. For extension work $50,000 was appropriated for next year, and $75,000 for the year following. An additional grant of $30,000 a year was made for agricultural extension, and $20,000 a year was provided for farmers' institutes.

MR. JOHN FRITZ, of Bethlehem, Pa., in whose honor a gold medal was founded on his eightieth birthday by the four great national engineering societies, has given $50,000 to Lehigh University for an engineering laboratory.

DR. E. F. NICHOLS, professor of experimental physics at Columbia University, has been elected president of Dartmouth College, where he was head of the department of physics from 1898 to 1903.

AT the June meeting of the board of trustees of the University of Arkansas a college of agriculture was established. Dr. C. F. Adams, acting director of the Experiment Station, was promoted to the deanship and directorship of the college and station.

MR. ALFRED C. LANE has resigned his position as state geologist of Michigan to take effect on September 1. He will be in Houghton during most of the summer. After September 1 his address will be Tufts College, Mass.

H. E. JORDAN, Ph.D., adjunct professor of anatomy (in charge of histology and embryology) at the University of Virginia, has been promoted to the rank of associate professor.

DR. M. W. BLACKMAN (Harvard '05), of Western Reserve University, has been elected assistant professor of zoology in Syracuse University. He will succeed Mr. B. G. Smith, who has accepted the position of instructor in zoology in the University of Wisconsin.

MR. F. G. SPECK has been appointed instructor in anthropology at the University of Pennsylvania, not at the University of California, as was incorrectly stated in a recent issue of this journal.

At the commencement exercises of Lehigh University the following announcements were made: Robert W. Hall becomes lecturer on forestry as well as professor of biology; Barry MacNutt, assistant professor of physics, is made associate professor of physics; Percy Hughes, assistant professor of philosophy, psychology and education, becomes professor of philosophy and education in charge of the department; Vahan S. Babasinian, instructor in chemistry, becomes assistant professor; James Hunter Wily, instructor in physics, becomes assistant professor; R. J. Gilmore is appointed instructor in biology.

DISCUSSION AND CORRESPONDENCE

MINIMAL QUANTITIES OF FOOD PRESERVATIVES

A curious instance of a fallacious argument cast in pseudo-mathematical form appears in the evidence of Dr. Harvey W. Wiley before the Committee on Interstate and Foreign Commerce, House of Representatives, in February, 1906. The argument is repeated in more deliberate language (identical in the three) in Bulletin 84, Part II., of the Bureau of Chemistry, of the Department of Agriculture (1906), at p. 754, in Foods and their Adulterations (1907) at p. 38 and in the *Proceedings of the American Philosophical Society*, Vol. 47 (1908) at p. 326. As the latter publications are readily accessible to the scientific world, I shall quote only the informal statement of the argument before the committee of the house:

> This is a graphic chart showing the comparative influence of foods and preservatives (Fig. 1). Of course we have to assume the data on which this chart is constructed. You will understand that.
>
> We will suppose that a normal dose of a drug is nothing. We do not need it at all. Now imagine that the lethal dose of a drug—that is, the dose that will kill—is 100, and then we go to work and measure at three points—at 75, at 50 and at 25. These are points at which we can measure. We can not measure up towards the right there, because the line almost coincides with the basic line, and the deviation is so slight that no method of measurement that we know of could distinguish them.

I omit here some reference to an error in the diagram which appears to have been corrected before printing.

The lethal dose of that drug is 100. That is written up there on the left. I will just trace that. The normal dose of a drug in the case of a person in health is zero. Then if we use a little drug I can measure it here. I can measure it

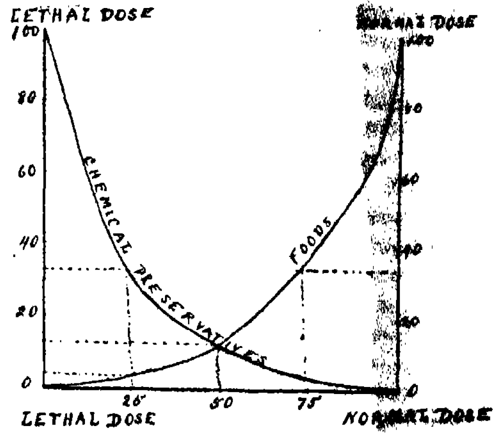


Fig. 1. Graphic Chart Representing the Comparative Influences of Foods and Preservatives.—Wiley.

again here (indicating) and I can measure it again here (indicating). Now from these three points I can construct a curve and calculate the lethal dose, which we will assume to be 100. That much drug would kill; no drug would not hurt at all.

The relative injury of a drug can be calculated mathematically from a curve constructed like that on experimental data, and I could tell you mathematically, by applying the calculus there, just what the hurtful value of that drug would be at an infinitely small distance from zero. You have doubtless, all of you, studied calculus, and you know how you can integrate a vanishing function. I used to know a good deal about calculus myself, and I could, by integral calculus, tell you the injurious power of a drug at an infinitely small distance from zero—that is, an infinitely small dose.

Now see what a contrast there is between a food and a drug.

The lethal dose of a food is none at all. That kills you; you are starved to death. The normal dose is what you eat normally, 100. I starve a man, and I measure the injury which he receives

at different points. I can mathematically plot the point where he will die.

That one chart shows to this committee in a graphic form, better than any argument could, the position of a drug in a food, as compared with the food itself. They are diametrically opposite. The lethal dose of one is the normal dose of the other, and *vice versa*. Therefore the argument de minimis as far as harmlessness is concerned is a wholly illogical and non-mathematical argument, and can be demonstrated by calculus to be so.

The reader is urged to refer to the more formal statement in either of the other publications, and to note the confusion of thought, by virtue of which deviation from the perpendicular line is (correctly) treated as the measure of injurious effects in the case of food, but deviation from the *horizontal* (!) line, as the measure in the case of drugs.

The argument contains three fallacies so patent that (to adapt words employed by the witness in criticism of those who hold the opposite opinion)[1] "it seems astonishing in these days of rigid scientific investigation that such fallacious reasoning can be seriously indulged in for the sake of proving" the *harmfulness* of minute quantities of non-condimental preservatives.

First and most important. Absolutely no evidence is offered that the curves actually have the form which is assumed for them.

Second. "Food = 0" can not be regarded as the lethal dose in the same sense that "preservative = 100" is a lethal dose.

Third. Quantity of food and injurious effects can not be measured in the *same direction* in a diagram purporting to show the relation between them.

It seems almost incredible that, repeated by the author as the argument has been over and over again during the past three years, recast in language, scanned by his assistants, none of these fallacies has been convincingly borne in upon his mind.

A lethal dose of any substance is the quantity which, administered at one time, is sufficient to cause death. To assume food = 0 a lethal dose is to assert the absurdity that food (and indeed every individual food substance) must be taken every minute of one's life. On the other hand, it is undoubtedly true that excessive quantities of food (and of individual foods) produce injurious effects. Logically, therefore, the food curve in Dr. Wiley's diagram, whether it refers to food in general or to any individual food, should—after touching the right vertical axis at "100 normal dose"—turn back to the left, and reach a true point of lethal dose at a point above 100. That is to say, it should have the general form represented by *ABC* in Fig. 2. If there be such a thing as a lethal dose of food, is it not the quantity represented by this point above 100 rather than the zero quantity? This diagram makes it clear that the cases of

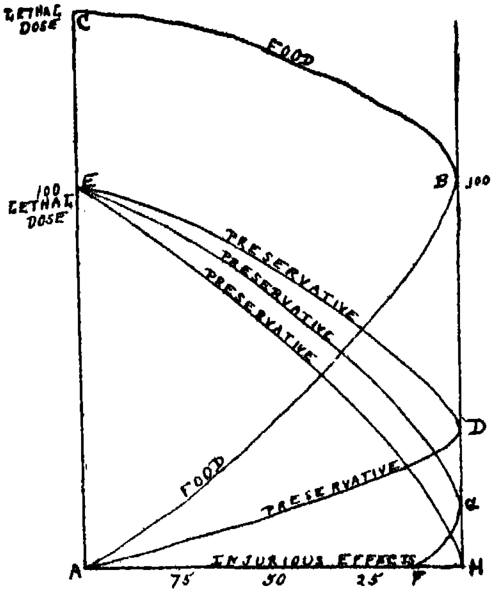


FIG. 2. Possible Forms of Curves Representing Injurious Effects of Foods and of Food Preservatives.

food and preservative are not diametrically opposite, as maintained by Dr. Wiley. Evidently the principle that any substance which is injurious in any quantity is injurious in all quantities, however small, is absurd as applied to food substances. And there seems no justification for laying down any principle "de minimis" which shall apply solely to preservatives or to non-condimental preservatives, or

[1] Page 249 of the evidence.

(most arbitrary limitation of all) to non-condimental preservatives not naturally present in the food.

In Fig. 2 are shown several possible forms for the preservative curve, alternate to the form given in Dr. Wiley's diagram. Two of these, ADE and FGE, represent the preservative as beneficial in small quantities and injurious in larger. The former represents the preservative as essential in some quantity; in other words, it would make the difference between food and preservative one of quantity merely, not one of kind. A curve of this kind is conceivable for a preservative such as benzoic acid or salicylic acid, both of which are normally present in minute quantities in many fruits.

The writer does not mean to assert that the curves for any preservatives have been shown to have the forms represented in Fig. 2. What he does wish to emphasize is that there is nothing in the mathematics of the case requiring them to have the form represented in Dr. Wiley's diagram, and therefore no justification for the argument that chemically preserved foods are injurious because the preservatives produce injurious effects when administered in quantities larger than would be contained in chemically preserved foods.

J. F. Snell

Macdonald College,
Quebec, Canada

THE CHALK FORMATIONS OF NORTHEAST TEXAS

In the *American Journal of Science* for May, 1909, Article XXIX. is entitled "The Chalk Formations of Northeast Texas," by Mr. C. H. Gordon, the substance of which is to prove that the two formations of Texas, originally defined by me as the Austin chalk and the Anona chalk, are identical.

If such is the case, and I have long believed that it might be so, Mr. Gordon would do a service to science in proving the fact. I think, however, that in this paper where the author has entered into the question of record, his statements are neither complete nor accurate.

I spent many years of my life in endeavoring to define the many Cretaceous formations of my state, and to disentangle them from previous confusion. The various contributions thereon were progressive, and after the date of the last paper cited (1893) by Mr. Gordon as coming from me and before I retired from the subject, I learned and published much. A final work was published in which the previous results were summarized and errors corrected. Furthermore, the uncertainty as to the position of the Anona chalk was clearly stated. It certainly would seem a matter of justice for Mr. Gordon, in citing my views, to cite the latest published ones.

In the final work alluded to I clearly stated on page 341:

> That the writer has considered this chalk (Anona) to represent a higher horizon than the Austin chalk, but its exact relationship is a subject of future determination.

Also on page 337 I note the difficulty "owing to the lack of (continuous) outcropping sections" of separating the Austin chalk from the Navarre formations in the Red River district.

Furthermore, in discussing the correlation south of Red River of the various members of the Upper Cretaceous in northeastern Texas, I confessed my "utter inability, notwithstanding the years of study, to correlate the various outcrops of these beds, nor can it be done by minute paleontologic research, such as he (the author) has not had opportunity to undertake," and such as Mr. Gordon confesses he has not undertaken.

Mr. Gordon does not even mention the paper above quoted, which was my last work on the Cretaceous and which is entitled "Geography and Geology of the Black and Grand Prairies, Texas, Twenty-first Annual Report of the United States Geological Survey," Washington, D. C., 1902.

So far as the writer is concerned, it is a pleasure to see other workers continue the researches in the geology of Texas, where there are hundreds of problems and details still unsolved and unrecorded, but I do think it fair that if an author endeavors to present a record of previous researches, and opinions, that they should be cited fairly. The score or

more of formation names of my own invention utilised in Mr. Gordon's article without credit, at least, attest that the studies of the Texas Cretaceous by me left some impress upon the subject.

ROBT. T. HILL

THE DAYLIGHT SAVING BILL

TO THE EDITOR OF SCIENCE: On page 453 of SCIENCE for March 19, 1909, a reference to the "Daylight Saving Bill" is introduced by the statement: "It is said that the Ohio state legislature once passed a bill establishing the value of π to accord with the views of some circle squarer."

A declaration beginning "it is said" is usually safe against correction, because anything may be "said," but in this instance I am moved to say that the laurel wreath has been put upon the wrong brow.

It was in Indiana, nearly twenty years ago, that such a bill was introduced by a member of the state legislature, but it was "laughed out of court," after making some progress in the lower house, as such measures often do where not much attention is given to the real meaning of every bill put upon the calendar. As far as I know, the legislature of the state of Ohio has not yet concerned itself with the ratio of the circumference of a circle to its diameter. After all, a good deal may be said for a state legislature that has devoted even a brief hour to an intelligent consideration of the value of π, and a careful investigation might show that the ability to do this is by no means restricted to regions east of the Allegheny Mountains. It is a well-known fact that of the Presidents of the United States serving within the last half century (barring one recently retired, who forms a class by himself), the two who were most appreciative of the work of scientific men and most capable *by reason of their own knowledge and experience*, of determining its value, were chosen, one from Ohio and one from Indiana, while that one least so was from the great Empire State. The record of the "middle west" in this respect is sure to be maintained during the administration just now beginning.

It is a serious mistake to put the author of the daylight saving bill in the same class with the circle squarers. The measure has been given much attention by all of the best English newspapers and periodicals during the past year and, with few exceptions, the criticisms have been most favorable. The passage of the bill has been urged by a very large number of eminent Englishmen, including many of the most distinguished men of science, and the advantages its adoption would secure are so many that it seems tolerably certain to receive the approval of parliament in the not distant future.

T. C. M.

DRESDEN, GERMANY

LIBRARY BOOK-STACKS WITHOUT DAYLIGHT

TO THE EDITOR OF SCIENCE: I was greatly interested in the short abstract of Mr. Bernard R. Green's address on "Library Book-stacks without Daylight," which appears in SCIENCE for April 9, 1909, p. 592.

I remember very well probably five or six years ago a conversation that I had with Mr. Green in connection with the new library building of the College of Physicians of Philadelphia, when I made the following suggestions, which I would like to put on record for the consideration of others.

It seemed to me that the ideal book-stack should be built with solid brick walls without any openings of any kind, and that even in the roof there should be no skylight and no openings except for the chimneys and ventilation. Artificial light could be turned on and off at will and would provide amply and inexpensively for the light. Forced ventilation would keep the air pure. This method of construction would have the following advantages:

1. A wall of solid brick is much cheaper than one with openings for windows, which must be filled with expensive wire glass, to which must be added the cost of iron shutters, with some automatic device for their closure.

2. It is a much better protection against fire.

3. It excludes all dust.

4. The book-stacks can be placed in the

stack-room at any distance; farther apart or nearer together, as required, irrespective of their relation to daylight through the windows.

5. As Mr. Green has pointed out, daylight is injurious to books.

6. The temperature of the room will be more equable, the internal heat being retained in the winter, and the external heat being excluded in the summer.

I hope, if this commends itself to architects and librarians, that some day the board of directors of a library may act upon it. The only drawback that occurs to me is that architecturally it would not be attractive in appearance, but as the book-stack is usually in the rear of the building and more or less hidden from view, I think this would not be a very serious objection.

W. W. KEEN

PHILADELPHIA,
April 30, 1909

SCIENTIFIC BOOKS

The Thirteen Books of Euclid's Elements Translated from the Text of Heiberg with Introduction and Commentary. By T. L. HEATH, C.B., Sc.D. Cambridge, University Press. 1908. Three vols.

Differential and Integral Calculus. By DANIEL A. MURRAY, Ph. D., Professor of Applied Mathematics in McGill University. New York, Longmans, Green and Co. 1908. Pp. xviii + 491.

An Elementary Treatise on the Differential Calculus Founded on the Method of Rates. By WILLIAM WOOLSEY JOHNSON, Professor of Mathematics at the United States Naval Academy, Annapolis, Maryland. New York, John Wiley and Sons. 1908. Pp. x + 191.

In these days of prolific writing when even the worst books (if indeed such a lower limit exists) must be "noticed" and the best, owing to consequent lack of space, may not be really reviewed, one is at a loss to know how properly to signalize the appearance of so important and excellent a work as this latest production from the pen of Dr. Heath. Of this work it is safe to say—and that is much—that no other better illustrates the great service of British scholarship in rendering the ancient classics accessible and attractive to our time, and no other better illustrates the truth of Cousin's *mot: La critique est la vie de la science.* No account of the work can be bad if it has the effect of inducing the reader to procure a copy for himself, and no account can be good if it have the opposite effect. For students and teachers of mathematics or of philosophy, this edition of the "Elements" may be said to be indispensable.

It is only after examination of the volumes that one can realize how utterly impossible it is to convey in a few lines anything like an adequate conception of the riches that Dr. Heath has given us. Nevertheless, a few hints—the meagerest of indications—must be given. The introduction, which occupies more than a third of the first volume, is composed of nine chapters, entitled Euclid and the Traditions About Him, Euclid's Other Works, Greek Commentators other than Proclus, Proclus and his Sources, The Text, The Scholia, Euclid in Arabia, Principal Translations and Editions, and (ninth chapter) On the Nature of Elements, Elements Anterior to Euclid's, First Principles, etc. Of the man Euclid, as of many another great determinator of the world's career, but little is known, and the chapter on Traditions, though it furnishes nothing new, is valuable as collecting, sifting and citing the literature of the old. One of the traditions, whether or not it be true in fact, is at all events true in spirit, and will be relished by that variety of practician engineer who views mathematics as he views a wheelbarrow or a spade. "But what shall I get by learning these things?" said a pupil to Euclid after learning the first theorem. Thereupon Euclid called his slave and said, "Give him threepence, since he must make gain out of what he learns." The late Sylvestre, it is remembered, on being asked to state the "use" of the theory of substitution groups, on which he had been lecturing, replied, "I thank God that, so far as I know, it hasn't any." It would be interesting to know what proportion of scientific men are aware of the fact that Euclid wrote several scientific works other than the "Elements," as the hopelessly lost "Pseudaria," said by Proclus to be "by way

of cathartic and exercise," designed, that is, to aid the beginner in the discovery of paralogisms and in the discrimination of true principles from the specious and false; the still extant "Data"; the book "On Divisions (of Figures)," which though "lost in Greek," "has been discovered in the Arabic"; the three lost books of "Porisms"; the two works entitled "Surface-loci" and "Conics," both lost; the still extant "Phænomena," an astronomical work; and the "Optics," edited by Heiberg in 1895. In the two chapters (27 pages) devoted to Greek commentators upon Euclid and especially to Proclus and his Sources, Dr. Heath has given not only detailed citations of the immense body of literature bearing upon these matters, but—what is far more—a most luminous and valuable digest of it all. Then follows the chapter of 18 pages dealing with the text. Here we have an interesting account of the several celebrated manuscripts from which knowledge of the content of the "Elements" is mainly derived, a statement of the critical principles followed by Heiberg in the comparison and evaluation of the sources, and a good indication of the ingenuity, of the prodigious scholarship, labor and devotion that enabled Heiberg to produce his monumental work on Euclid. This work was published between 1883 and 1888. It is the "definitive text" contained in it that Dr. Heath has translated into English and that his scholarship has enabled him to set in the light of modern researches into the foundations of geometry. In view of the empire that Euclid has exercised in British education, it is especially interesting to learn, in the chapter on Translations and Editions, page 95, that the great Greek classic, or some portion of it at all events, found itself in English dress as early as the first half of the tenth century. In support of this contention, Dr. Heath cites the following quaint lines from "Rara Mathematica":

> The clerk Euclide on this wyse hit fonde
> Thys craft of gemetry yn Egypte londe
> Yn Egypte he tawghte hyt ful wide,
> In dyvers londe on every syde.
> Mony erys afterwarde y understonde
> Yer that the craft com ynto thys londe.
> Thys craft com into England, as y yow say,
> In tyme of good kyng Adelstone's day.

If among the many students of recent American and English, Italian and German work in the foundations of geometry, there be any one who imagines that nearly all of the fine things presented in such work are new, there await him in the closing chapter of Dr. Heath's introduction a pleasant surprise and a happy emancipation. Indeed this chapter of 38 large octavo pages is an exceedingly valuable contribution to the historico-critical literature that pertains to the common ground of logic and mathematics. In it is set forth in clear and orderly fashion the best thought—and how fine and penetrating much of it is!—of pre-Euclidean and post-Euclidean philosophers and geometricians from Plato and Aristotle down to Proclus—a period of nine centuries—the best thought, I say, of the best intellects of antiquity regarding such eternally interesting matters as the nature of scientific (and especially) geometric *elements*, of the nature and significance of *axioms* (or common notions) and *definitions*, of *hypotheses* and *postulates*, of *existence assumptions* and *existence proofs*, of *theorems* and *problems*, *lemmas*, *cases* and *porisms*, of methods of *argument* and *demonstration*, *objection*, *reduction*, *analysis* and *synthesis*. Much that has been recently written about these things is new and much of it is but repetition—repetition that is sometimes inferior in point of form and doubtless often unconscious. It is no small service to give the reader, as Dr. Heath has here done, a lively sense of the scientific atmosphere in which Euclid wrote and of his indebtedness and through him that of all subsequent time to his predecessors and contemporaries. Aristotle's statement, quoted by Heath from the "Posterior Analytics," that, "other things being equal, that proof is the better which proceeds from the fewer postulates or hypotheses or propositions," reminds one of the famous dictum enunciated sixteen hundred years later by the "Doctor invincibilis," William Occam: ***Entia non sunt multiplicanda præter necessitatem***. Nothing conveys better the animating spirit of the

modern critical movements in logic and mathematics.

The remaining 273 pages of the first volume are devoted to books I. and II. of the "Elements." The entire discourse is conducted in the most admirable manner. First are given in clear, bold, beautiful type the definitions, axioms and postulates of book I. Each of these is then taken up in order, restated in Greek followed by the English equivalent, and made the subject of an elaborate and lucid historical and critical commentary. The extent of Dr. Heath's commentaries may be inferred from the fact that no less than eighty-five large pages are occupied by discussion of the thirty-three definitions, axioms and postulates of the first book, the immense wealth of the material presented being gathered from all the principal sources from pre-Euclidean times to the present. Then follows the statements and demonstrations of the propositions of book I. with critical discussion of each. The remaining twelve books are treated in similar fashion. The third volume closes with the so-called "Book XIV." by Hypsicles, a note on the so-called "Book XV.," a carefully prepared list of addenda et corrigenda, an index of Greek words and forms, and an excellent general index to the entire work.

Dr. Heath has been animated by no narrow or partisan spirit. Like every other well-informed student of mathematics, he is well aware of the fact that the time is long since gone when the reading of Euclid was indispensable to one who would become a learned or a productive geometrician. And in so far as this new edition may be regarded as a plea for the "Elements," it is an enlightened plea, one entirely worthy of its great theme, the noblest plea in English speech for the Alexandrine classic.

The content of Professor Murray's book has been taken chiefly from his "Infinitesimal Calculus," though some matter relating to indeterminate forms, solid geometry and applications to motion has been added, and the treatment of several topics has been revised. Among the noteworthy features of the work may be mentioned that it contains more than can be properly read in the time usually given in the best schools to a first course in the calculus; that in view of this fact certain articles have been indicated as constituting a course suitable for "students having a minimum of time"; that the book begins with a discussion of certain problems designed to foreshadow the nature of the calculus and a presentation of such algebraic notions as are of most frequent use in the calculus; that the subject is presented with modern regard—rather too much than too little, if it errs in either respect—for precision and rigor; that, though the subject is divided into differential calculus and integral calculus, the notion of anti-differentiation is presented in connection with that of the direct process; that, with a view to facility of applications, the view of integration as summation is put in advance of the other view; that numerous examples including simple applications to geometry, physics and mechanics, with illustrative solutions, are inserted in connection with the development of cardinal ideas and processes, a table of answers being given at the end of the volume; that unusual care has been given to accentuation of important matters; that especial attention has been accorded to the concepts of speed, velocity and acceleration; that, for alternative or fuller treatment of numerous ideas, the reader is referred to a good deal of the better and more accessible literature; and that there is given a brief introduction to differential equations and a table of integrals. The work is adequate to the needs of the college student, to the technological student and to the rarer spirit preparing for higher flights.

Professor Johnson's book is an abridgment of his "Differential Calculus" and is based on the method of rates. It is distinguished by the absence of the histological methods of the rigorists. Things are presented pretty much at their face values, being shown graphically rather than laboriously proved by help of the refined logical machinery brought in from across the sea. The English is excellent, everything moves along with the calmness, dignity and facility of an elder day, and the reader, while acquiring much useful knowledge, will acquire also a degree of confidence that in these critical times is apt to be rare

and is apt also to suffer mitigation in the course of subsequent study.

C. J. KEYSER

COLUMBIA UNIVERSITY

Hopi Songs. By BENJAMIN IVES GILMAN, Secretary of the Museum of Fine Arts, Boston, Mass. Hemenway Southwestern Expedition. A Journal of American Ethnology and Archæology. Fifth and Concluding Volume. Pp. xi + 235. Boston and New York, Houghton, Mifflin Company. 1908.

The text of the volume is divided into three sections: I., The Rote Song of the Hopi; II., The Phonographic Method; III., Notation, Diagrams and Comments. Seventeen Hopi songs are included in section III. A brief account of The Hemenway Southwest Expedition closes the volume.

The author opens his treatise by saying:

> The study of Hopi, or Moqui, singing, to which this volume is devoted, completes an inquiry into Pueblo music begun in 1891 with a study of Zuni melodies. The records upon which both investigations have been based were obtained in Arizona by Dr. J. Walter Fewkes, now of the Bureau of Ethnology, Washington, at the time in charge of the Hemenway Southwestern Expedition, who first applied the phonograph to the preservation and study of aboriginal folk-lore.

Of his previous study the author writes (p. 11):

> The major thesis of the "Zuni Melodies"—that Pueblo music is without scale—is strongly confirmed by this cumulative evidence. The diatonic form of the Hopi songs is (*a*) harmonic necessity or (*b*) apperceptive illusion. In large measure their adiatonic features are at once (*c*) intentional and (*d*) inexplicable by interpolation and transposition. The minor thesis of the "Zuni Melodies"—that "In this archaic stage of the art the scales are not formed but forming"—is rather weakened than corroborated by a closer study of Pueblo music. Its bent toward change inspires a doubt whether, unless by outward compulsion, it would ever submit to the trammels of a system. It appears an unhistoric rather than a prehistoric art.

Under the head Scales an Instrumental Product; the Voice Determining their General Form, the Ear, the Hand and the Eye their Varieties, the author skillfully proceeded to show that "Although the voice provides the raw material for scale building," the instruments have rendered service, so that

> It would appear that while still disembodied music tends to remain adiatonic, though always of necessity diatonoid. Only when incarnate by instrumental constraint does it chose, because it must, the best of all possible yokes.

Other factors have influenced scale development so that

> Scales may result with which the voice has had little to do, giving back to music, at the convenience and pleasure of ear and hand and eye, a semblance of the liberty of its vocal stage.

Under the head of Freedom, a characteristic of Pueblo music, the author writes:

> Apart from the tendency to consonant intervals no metes and bounds to invention manifest themselves in these melodies, and they may apparently be altered by every performer.

In this connection a footnote calls attention to a fact presented at Berlin in 1888 before the International Congress of Americanists that

> The anatomists of the Hemenway Southwestern Expedition found the hyoid bone of the ancient skeletons exhumed on the Rio Salado exceptionally elastic in structure. The position of this bone at the base of the tongue makes it an important factor both in speech and song.

This fact should not be forgotten when considering the data presented in this volume as of wide application. Nor can the statement that songs "may apparently be altered by every performer" be accepted as true of Indian songs in general. Accuracy in the rendition of a song, particularly of one that was a part of a religious ceremony, was insisted upon. In some of the tribes a mistake, or variation, in singing a song, constituted so grave a matter that it put a stop to the ceremony, until after a rite of contrition had been performed; that being finished the ceremony had to begin afresh. That there were slight variations in pitch and intonations was true, but they were such as occur among ordinary singers and did not affect the movement and flow of the melody, which the

singers were careful not to disturb, as the song in all religious rites was regarded as a message to the supernatural.

Section II. deals with The Phonographic Method. The author says of the phonograph: It "makes possible a hitherto unheard-of thing, the detailed study of an individual performance of music. It opens a field of investigation, that of the actual events of which music consists, which has hitherto been accessible to observation in only a very limited way—while a performance lasts, and in so far as it can afterward be recalled by memory." From the premise that "Music is an art of interval and measure primarily, and one of timbre secondarily" the author proceeded to a phonographic study of interval in Hopi singing. He says:

With a series of tests not psychological but physical I endeavored both to find the principal limitations of the instrument by the trial of various conditions of inscription and reproduction, and to determine the degree of exactness of its best performance. The method consisted mainly in noting the amount of variation in the rapidity of pulsations of sound called beats produced between a phonographic reproduction of a note held continuously and another note known to be of constant pitch.

Then follows a lengthy account of his work upon these tests and the conclusion:

As an apparatus for the reproduction of textures of interval the phonograph may fairly be called an instrument of precision.

Of the "method and symbolism of the notation" we read:

Like the records of Zuni music these . . . are the result of an attempt to judge the tones delivered by the phonograph by means of the sense for difference of pitch alone, without aid from the sense of interval. My aim has been to make a separate estimate of the pitch of each individual note of each performance, through its comparison with one or more of the series of tones at intervals of a tempered semi-tone, or 100 cents, given in the notes of an ordinary harmonium. This comparison was made, as before, by silencing the phonograph the moment the note to be judged had been reached, and immediately therafter sounding a harmonium note. . . .

For the expression of "the minute scale of fourteenths of a tone made the basis" of his records the author adopted modifications of the historical notation by which he says:

There is thus afforded for each of the fourteenths of a tone assumed as the steps in the scale of these notations a gradation of position easily distinguishable from every other.

He further remarks:

The attempt to follow the musical practise of non-European peoples with such minuteness must justify itself, either on the ground that accuracy of observation is a thing worthy to be aimed at for its own sake, or on the ground that in this branch of research such a degree of it has veritable value for purposes of theory.

Section III. is composed of the presentation of each of the seventeen Hopi songs; given first on the usual clef, next the phonographic record according to his plan of notation, then a chart showing the "Course of Tone," followed by more or less elaborate "Comments." In some of these latter the author shows a fine appreciation of "these wild flowers of fancy, the wanton yield of naïve delight in the vocal production of interval," as in connection with "Snake Song No. 4" where he says:

The interest of the song lies in its stately rhythm, occasionally delicately varied; and in this deliberate ascent, as if from level to level of the singers native mesa, with a pause midway in each to rally loiterers.

The volume represents much careful work and is a valuable contribution to the study of the phonetics of some kinds of Indian singing. The quality of tone is not touched upon and unfortunately the songs under consideration do not present a wide range of rhythms so that that interesting aspect is not dwelt upon. All the records under examination are from single singers. The Indian solo singer is apt to waver more in pitch than when he sings with a group. A number of voices not only strengthens the tone but steadies the interval. Moreover, comparatively few Indian songs are intended to be sung by one voice only, so that such records as those presented in the volume can hardly be regarded as representative of Indian music. They do not picture the songs as they appeal to the Indians, nor does the dissection of tones, as here so ably given, assist our race to dis-

cern the beauty that lurks in a vast number of the songs of the American Indian.

ALICE C. FLETCHER.

SPECIAL ARTICLES

THE DORSAL SPINES OF CHAMELEO CRISTATUS, STUCH

SINCE the discovery of the long-spined Pelycosauria, in Texas, no similar condition has been reported in any living form. Cope referred to the dermal spines of *Iguana* and *Basiliscus* as the nearest condition to that of the fossil forms. Baur noted one or two lizards in which one or two spines were a little longer than the others. Through the kindness of Dr. A. G. Ruthven, curator of the Museum in the University of Michigan, I have been enabled to examine a specimen of *Chameleo cristatus* from Efulen Kribi in the Cameroon district, sent to the museum of the university by the Rev. Geo. Schwab, a missionary. The accompanying figure shows the condition of the spines of the vertebræ. The elevated neural spines beginning with the axis extended to the tenth caudal and then rapidly diminish in size on the long and slender tail. At the base of the larger spines there is a very slight enlargement indicating the attachment of the dorsal muscles which reached to that point. The upper ends of the spines were attached by a strong thread of connective tissue and the interspaces between the spines were filled by a very thin membrane of the same tissue. A few scattering threads of muscle were dispersed over the membrane. The condition of this specimen is of great interest as it shows almost exactly the conditions which have been imagined to exist in the Pelycosauria. In the literature of this group I find the presence of the elevated neural spines mentioned but they have not been figured and have never been referred to in explanation of the Permian forms.

Vertebral column of *Chameleo cristatus* Stuch, from Efulen Kribi, Cameroon, showing elevated neural spines.

Unfortunately this gives us no hint of the use of the elongated spines in the ancient forms. Only two species of the genus, *cristatus* and *montium*, have the elevated spines; the others have a crest supported by dermal rods. The habits of the forms are not sufficiently well known to make any suggestion as to the use of the crest or spines. It is perhaps significant that the chameleons are a highly specialized and decadent group just as the Pelycosauria were and that there is a decided tendency to develop seemingly useless horns and spines in other parts of the body just as there was in the Pelycosauria. It leaves one with the same impression of some sort of physiological excess of growth.

E. C. CASE

UNIVERSITY OF MICHIGAN

ON THE CHEMISTRY AND DEVELOPMENT OF THE YOLK PLATELETS IN THE EGG OF THE FROG (RANA PIPIENS)

THE yolk platelets in the frog's egg contain 6 per cent. of lecithin and 94 per cent. of a proteid having the following composition: 1.21 per cent. of phosphorus, 1.32 per cent. of sulphur and 15.14 per cent. of nitrogen. I used gravimetric methods in determining phosphorus and sulphur and the Kjeldahl method in determining nitrogen. This composition and the precipitation reactions of the proteid indicate it to be a nucleoalbumin related to the vitellins and ichthulins of the yolk of the eggs of birds and fish, hence I will call it batrachiolin.

In the germinal vesicles of the ovarian eggs nucleoli arise from the chromatin. These nucleoli grow and multiply by fission and budding, and during the fall of the year migrate

into the cytoplasm, where they break up into finely granular masses called yolk nuclei. The yolk nuclei become more or less diffused through the cytoplasm, and, especially toward the egg membrane, give rise to the yolk platelets, which are at first minute, but grow during the winter to large size. Thus the nucleoalbumin of the yolk platelets is derived from the nucleoproteids of the nucleus.[1] Whereas I am entirely ignorant of the steps by which a nucleoproteid might be changed into a nucleoalbumin, the phosphorus content of the egg nucleoalbumins (.4–1.5 per cent.) is about the same as that of the native nucleoproteids studied by Halliburton.[2] We might compare the migrating nucleoli to the trophochromatin of the protozoa and metazoa.[3] Whereas the nucleolus is more acidophilous to stains than the idiochromatin (chromosomes), it is more basiphilous than the general cytoplasm, and I see no objection to calling it trophochromatin. Goldschmidt[4] found the chromidia (trophochromatin) of some protozoa to give rise to "glanzkorper" or glycogen granules which might be compared in function to the yolk platelets of the frog's egg.

Whereas I found that the nucleoli were of greater specific gravity than the nuclear sap, and could be thrown out of the germinal vesicle by centrifugal force, there is no indication that gravity aids in the normal extrusion of the nucleoli. Such migration of nucleoli is a wide-spread phenomenon in animals and plants.[5]

J. F. McClendon

University of Missouri,
May 15, 1909

THE STRUCTURE OF LILY PISTILS

In an extended study of the structure of the pistils of Liliaceæ some results have been reached that warrant the publication of this preliminary note pending the completion of the work.

The pistils of the lilies are in general alike. However, certain differences exist among them (1) in regard to the formation of the partition walls of the ovary and (2) in regard to the development of the ovules. It is the prevailing opinion among botanists that the margins of the carpels in the Liliaceæ infold to form the partition walls of the ovary and also to produce the ovules. This is true of some lilies but it is not true of all lilies. It has been found that certain lilies develop the partition walls of their ovaries, also their ovules, from the middle portion of their carpels. In this type of ovule-production the midribs of the carpels become thicker, push in to the central axis of the ovary, unite and produce the ovules.

The following plants have been found to develop their ovules from the midribs of their carpels: *Lilium longiflorum* Thunb., *Lilium longiflorum eximium* Nichol., *Lilium candidum* Linn., *Erythronium albidum* Nutt., *Convallaria majalis* Linn., *Tradescantia bracteata* Small, *Zebrina pendulata* Schnitzl., *Tulipa* sp.

Charles E. Temple

The University of Nebraska

[1] The amphibian nucleolus is said by Carnoy and Lebrun to contain a small amount of nucleoalbumin.

[2] *Jour. of Physiol.*, Vols. 17 and 18.

[3] Cf. Moroff, *Arch. f. Zellforschung*, Vol. 2.

[4] *Arch. f. Protistenkunde*, Vol. 5.

[5] Walker and Tozier, *Quart. Jour. of Exper. Physiol.*, Vol. 2.

SOCIETIES AND ACADEMIES

THE IOWA ACADEMY OF SCIENCE

The twenty-third annual meeting of the Iowa Academy of Science was held at the State University, Iowa City, on April 31 and May 1. A public meeting was held on the evening of April 30 for the presentation of the address of the president, Professor Samuel Calvin, on "The Work of the Iowa Geological Survey," and a lecture by Professor William A. Locy, of Northwestern University, on "The Service of Zoology to Intellectual Progress." Before the beginning of the evening program Professor C. E. Seashore gave demonstrations of the tonoscope in his laboratory.

In the progress of the two sessions of the academy the following papers were presented:

Comet C, 1908 (Morehouse): D. W. Morehouse.

An account of the comet discovered in September, 1908, while photographing at the Yerkes Observatory.

The Polyporaceæ of Fayette, Iowa: Guy West Wilson.

Some Parasitic Polyporaceæ: C. D. LEARN.

The present paper embodies the results of a field study of the commoner local species of the family. The economic and pathological aspect of *Polyporus ignarius*, *P. fulvus*, *P. everhartii* and *Elfvingia megaloma* are discussed.

An Anatomical Study of the Roots and Rhizomes of a Few Weeds: L. H. PAMMEL and ESTELLE D. FOGEL.

It is a very common practise in agricultural literature to refer to the rhizomes of quack grass and germander and other ground stems of this kind as roots. The morphology indicates that these are stems beyond a doubt. On the other hand the underground portions of the milkweed, Canada thistle and horse nettle are also referred to as roots by the farmer and correctly so, and yet quite a number of botanists have fallen into the error of calling these structures stems. The common morning glory is a stem. The histological structure shows beyond a doubt that they are true roots.

The More Important Factors concerned in the Production of Plant Diseases: L. H. PAMMEL and CHARLOTTE M. KING.

A brief survey and review of the fungus diseases occurring upon cultivated plants for twenty-five years in the state of Iowa. Giving dates for the epidemics of rusts and causes leading up to it, also a discussion of the more general problems of plant diseases and their relation to climatic conditions.

Plant Distribution in Iowa in Relation to Geologic Formations: B. SHIMEK.

The Sand-dune Flora of Iowa: B. SHIMEK.

The Flora of Iowa Rock, a Small Rocky Island in Puget Sound: ROBERT B. WYLIE.

Notes on Spore Formation in Ulva: ROBERT B. WYLIE.

Slime Moulds of the Yosemite: THOMAS H. MCBRIDE.

Preliminary report: (1) the locality: (*a*) altitudes, (*b*) general climatic conditions; (2) the season of collecting, and conditions influenced by altitude; (3) list of species taken, with notes; (4) probable results of further explorations.

Okoboji Laboratory: THOMAS H. MCBRIDE.

Some Features of Iowa Ground Waters, II.: W. S. HENDRIXSON.

The Training of the Technical Chemist: J. S. STAUDT.

This paper and the one following were presented before the Iowa Section of the American Chemical Society and were read before the academy by invitation.

The Influence of Copious Ingestion of Water: STELLA A. HARTZELL.

A Hysteresis Curve: D. W. MOREHOUSE and HARRY WOODROW.

The Googler Primary Cell: HARRY WOODROW.

On the Use of the Balance: LEROY D. WELD.

The Fifth and Seventh Cranial Nerves of Plethodon glutinosus: H. W. NORRIS.

A criticism of a recent paper by Dodds. The supposed anomalies in the fifth nerve of *P. glutinosus* are found to fall into line with the common arrangement in urodele amphibians.

The Migration of Nervous Elements into the Dorsal and Ventral Nerve-roots of Pig-embryos: ALBERT KUNTZ.

Embryological evidence is presented to show the fact of migration of nervous elements from the neural tube of the embryo into the dorsal and the ventral nerve-roots. An attempt is made to determine the nature of such migrating cells. General inferences touching neurological problems.

The Unios of the Muscatine County Loess: B. SHIMEK.

The following papers were read by title:

The Asteroid, 1906, W. E.: ELLIS B. STAUFFER.

Further Studies of the Eastern Nebraska Flora: CHARLES E. BESSEY.

Studies are now being made in the department of botany of the University of Nebraska of the plants now and formerly used by the Indians of eastern Nebraska, especially the Omaha tribe. It is found that many species of plants were formerly used that are not now in use, and within the last few years some plants have been brought into use that had not been previously used. It is hoped that a preliminary report can be made by the middle of the year.

The Estimation of Arsenic and Cobalt in Smaltite: NICHOLAS KNIGHT.

The complicated reactions, oxidation of the arsenic with chlorine. The separation of cobalt. The change in the valence of cobalt from two to three.

An Analysis of the Fruit of Viburnum nudum: NICHOLAS KNIGHT.

A continuation of the chemical study of wild fruits from Sylvan Beach, New York. The extraction and determination of the sugars. The organic acids. The extractions of the oils with ether.

The simplification equivalent of the oils. The weight of the ash and the determination of the ash constituents. The per cent. of the various constituents of the fruits.

The Action of Manure on a Certain Iowa Soil: E. B. WATSON.

The Solubility of Portland Cement Proved: G. G. and A. J. WHEAT.

The advanced studies on cement are demonstrating the power of water, at normal temperatures to dissolve and carry through a double filtering crucible. The silicates of lime and the aluminate of lime, as silicates and aluminates and these same dissolved silicates refuse to yield their calcium to HCl, but do yield after the soda carbonate fusion.

Some Geological Effects of Artificial Drainage in the Wisconsin Drift Region: G. G. and A. J. WHEAT.

Significance of Thrust-planes in the Great Basin Ranges: CHARLES R. KEYES.

The recent discovery of thrust-planes in certain of the desert ranges of the Great Basin region and of late Tertiary strata severely flexed and infolded with early Tertiary lava flows is taken as indicating that the entire region has been subjected to great compression during late geologic times and not to pulling strains that would produce profound normal faulting. The recent-fault theory for the origin of these mountains is therefore very seriously questioned.

Orotaxial Correlation of Geologic Terranes and Diastrophism: CHARLES R. KEYES.

The similarity of the two methods is pointed out and their great value emphasized as means of exact correlation of geologic formations. Attention is also called to the fact that the proposition of this method was presented before this academy more than a dozen years ago and a full decade prior to the general acceptance of the principles by geologists generally. It supplants the methods by means of fossils.

Carbonic Column of the Rio Grande Region: CHARLES R. KEYES.

The results of some recent observations are briefly discussed, as bearing upon the Carbonic history of our Iowa rocks. The Carbonic section of the region is very much more complete than in the Mississippi Valley; and in fact more extensive than anywhere else on the North American continent.

Hydroids as Ornamental Plants: C. C. NUTTING.

Arterio-sclerosis: W. E. SANDERS.

Birds of Polk County, Iowa: LESTER P. FAGEN.

Some Observations on the Embryology of Chironomus: W. N. CRAVEN.

L. S. ROSS,
Secretary

DES MOINES, IA.

THE TORREY BOTANICAL CLUB

THE meeting of April 28, 1909, was held at the New York Botanical Garden, with Dr. Tracy E. Hazen in the chair.

Dr. William A. Murrill, chairman of the cryptogamic section of the committee on the local flora, made a report in which the following suggestions were submitted:

(1) The publication of keys and lists of local species for field use; (2) the preparation of a map of the territory included; (3) cooperation with other botanical clubs within or bordering on this territory; (4) cooperation with the field committee in the selection of suitable places for excursions and the care of cryptogamic material collected on these excursions; (5) the use of a given space in *Torreya* for notes upon and additions to the local flora; (6) a joint meeting at an early date with the phanerogamic section of the committee on local flora.

The scientific program consisted of a discussion of "The Cactuses of the West Indies" by Dr. N. L. Britton.

The speaker referred to the distribution of cacti in the West Indian Islands and the regions inhabited by them; these are mostly on the southern side of the larger islands, where the rainfall is very low and where these plants are very abundant, certain portions of the southern side of eastern Cuba and of Jamaica being actual cactus deserts. On the smaller islands the cacti grow less abundantly and mainly at low altitudes. The genus *Rhipsalis* forms an exception to the general xerophytic distribution, its species growing on trees and cliffs in relatively moist regions. Southern Florida contains several species similar to some of those growing on the Bahamas and in Cuba or identical with them. After a preliminary description of the plants the meeting adjourned to the propagating houses of the New York Botanical Garden, where specimens of living cacti, including nearly all the known species of the West Indies, were exhibited and described.

PERCY WILSON,
Secretary

SCIENCE

FRIDAY, JUNE 25, 1909

CONTENTS

MSS. intended for publication and books, etc., intended for review should be sent to the Editor of SCIENCE, Garrison-on-Hudson, N. Y.

THE BIOLOGICAL LABORATORY OF THE BUREAU OF FISHERIES AT WOODS HOLE, MASS.

REPORT OF THE PAST YEAR'S WORK, AND ANNOUNCEMENT FOR THE COMING SEASON

IN the spring of 1908 two of the larger rooms of the laboratory were equipped for chemical investigations, and during the succeeding summer these rooms were occupied by five chemists who were engaged upon various problems of organic analysis. The purchase of books for the library has been continued, and five new periodicals have been added to the list of those which will henceforth be received here. These are the *American Journal of Physiology, American Journal of Anatomy, Journal of Experimental Zoology, Anatomischer Anzeiger* and *Centralblatt für Physiologie.* A considerable number of volumes, including the back numbers of several important journals, were loaned for the season by the library of the Bureau at Washington, and it is hoped that this profitable arrangement will be continued in the future. The entire library of the Woods Hole laboratory has been transferred to glass cases, and will henceforth be more effectively protected against the summer fogs.

Thirty-one investigators were occupied with various researches in marine biology or biochemistry during the past season. Of these eighteen received salaries from the bureau, either as investigators or as scientific assistants. In addition nine other assistants were comprised in the laboratory staff. The subjects of research were as diversified as in past seasons, though problems of economic importance perhaps received a rather larger share of attention.

Among the topics of investigation may be mentioned: chemical analyses of the tissues and the eggs of certain marine organisms, the natural history of the sea-mussel and other mollusks, the reactions of marine organisms to light and to chemical stimuli, hybridization in fishes, the parasites of fishes, taxonomic studies of cœlenterates, bryozoa and crustacea, and various other problems in general physiology, ecology, cytology and embryology.

The season was marked by an endeavor to bring about more intimate social relations among the investigators of the Fisheries Laboratory themselves, and between the latter and those of their neighbor, the Marine Biological Laboratory. With this object in view, several informal "smokers" were held in the course of the summer, and by general agreement these occasions were regarded as highly successful, both in the furtherance of friendly cooperation among the local scientific colony and the stimulus given to individual efficiency. At the close of September, Woods Hole was visited by a considerable delegation from the Fourth International Fisheries Congress, which had just concluded its formal session at Washington. The visitors were conveyed to Woods Hole from Wickford, R. I., upon the steamer *Fish Hawk*, leaving for Boston by rail on the same day. The delegation included some distinguished fisheries experts and men of science from Europe, Asia and North and South America.

At the present writing, the long-heralded report upon the local biological survey is very nearly completed and with little doubt will be ready for publication by the close of the present summer. The following sections of this laborious work are now finished: (1) The list of organisms (so far as identified) which were taken at each of the 424 dredging stations. This station record covers over 750 manuscript pages and includes about 450 species of animals and about 90 species of plants. (2) Maps showing the distribution of all of those species which were taken at ten or more of the dredging stations.[1] There are more than 200 of these representing the fauna, about 40 representing the flora. Other charts have been prepared, showing character of bottom, water temperature and density at various seasons, geographical relations, etc. (3) The census of the local marine fauna and flora, based upon the survey dredgings and upon all other available data. The resulting annotated list occupies about 700 manuscript pages and records the occurrence of some 1,400 species of animals and over 250 species of plants. (4) The general account of the project, with summarized results, discussion, etc. This has only been finished in the rough. A final draught will be made during the next few months, thus completing the report. A brief discussion of the work, containing some of the more important general conclusions, was prepared by the writer for the Fourth International Fisheries Congress, and is being published in the proceedings of that congress.

In response to an appeal from the health board of Salem, Mass., the director of the laboratory was instructed by the commissioner to detail one of the investigation staff to visit that city for the purpose of inquiring into the cause of a serious mortality among the fishes in that neighborhood. Dr. C. L. Alsberg was chosen for this mission, and proceeded at once to the seat of the trouble. He found that enormous numbers of fishes, chiefly herring and whiting, had been stranded along the waterfront of the city, causing serious discom-

[1] This basis of selection has not been adhered to strictly either for animals or for plants. In the case of the plants the number of such species would in reality considerably exceed that given.

fort to the inhabitants, if not actually menacing their health. There was no evidence of an epidemic among the fishes, as had at first been feared. Great schools of them had come into dangerously shoal water, perhaps as the result of pursuit by predaceous species, and had been stranded by the receding tide. There was thus nothing to be done but to remove the offal, and to pray that the catastrophe might not be repeated.

A few notes seem worth while regarding certain species of animals which have been taken at Woods Hole, during the past year. *Orthopristis chrysopterus*, a fish belonging to the family Hæmulidæ, which is common farther south along our Atlantic coast, was taken for the first time in the vicinity of Woods Hole. A specimen of the "flasher" or "triple-tail" (*Lobotes surinamensis*) was captured at Nantucket. There have been very few previous records of the occurrence of this fish locally. A small crab, *Dissodactylus mellitæ*, which lives in association with echinoids of the "sand dollar" type, was taken in Vineyard Sound, though probably not for the first time. A curious case deserves mention of one fish becoming encysted within the body of another. In May, 1908, Mr. V. N. Edwards chanced to open a large hake (*Urophycis tenuis*) in the course of his search for parasitic worms. The hake seemed to be in perfect health and its stomach was nearly filled by a whiting, which had been recently swallowed. Upon examining the body cavity, a long slender object was found, completely inclosed within a fold of the peritoneum. This proved to be a dead fish, having a decidedly "mummified" appearance. Its body was 25 cm. in length. Skin, and for the most part fin-rays, were lacking, and the flesh was much shrunken and extremely hard. From the general bodily proportions of this fish, and the presence of a frontal spine, it is believed by the writer to belong to the genus *Leptophidium*. Several members of this genus have been taken off the coast, at great depths, and it seems likely that the present specimen came from a considerable distance. It had probably been swallowed by the hake, escaping subsequently through the wall of the stomach, perhaps by using the frontal spine as a perforating organ. The stomach of the hake had evidently healed completely after this adventure.

The fact does not seem to have been hitherto recorded that the "hawk-bill" or tortoise-shell turtle (*Eretmochelys imbricata*) not infrequently reaches the coast of southern New England. Its occurrence has not been mentioned in any list of the reptiles of Massachusetts, and I have found no reference to its having been observed north of North Carolina. Small specimens of both the loggerhead and hawk-bill are, however, occasionally taken in local fish traps, and one or two of the latter have been preserved in the museum of the laboratory. A specimen ten or twelve inches long was taken among floating *Sargassum* by Mr. Edwards in August, 1908, and was kept for some time in the shark pool of the station. I learn from Mr. Edwards that individuals as large as eighteen inches long are not infrequently captured. This species is readily distinguished from the loggerhead (*Caretta caretta*) by the presence of four costal shields, instead of five as in the latter, and from the green turtle (*Chelonia mydas*) by the presence of two prefrontal plates on each side of the head.

The following is a list of the investigators present during the season, together with their subjects of research:

Carl L. Alsberg, Ph.D., instructor in biochemistry, Harvard University:[2] (1) chemical composition and food value of certain marine organ-

[2] Now pharmacologist in the Bureau of Plant Industry.

isms; (2) investigation of death of fishes at Salem, Mass. (*Salaried investigator.*)

Charles B. Bennett, graduate student in Brown University, assisted Dr. Alsberg in chemical investigations above mentioned. (*Scientific assistant.*)

William M. Clark, A.M., assistant in chemistry, Williams College, likewise assisted Dr. Alsberg. (*Scientific assistant.*)

Edgar D. Congdon, A.M., Austin teaching fellow in zoology, Harvard University: a comparison of the marine and the brackish-water representatives of certain species of mollusks. Mr. Congdon also acted as librarian of the laboratory.

Bradley M. Davis, Ph.D., Cambridge, Mass.: (1) botanical section of the biological survey; (2) cytological studies of marine algæ. (*Salaried investigator.*)

Donald W. Davis, professor of biology, Sweet Briar College: the effect of conditions acting at the time of the fertilization of the fish egg upon the subsequent size and proportions of the organism. (*Scientific assistant.*)

Irving A. Field, professor of chemistry and biology, Western Maryland College: (1) the utilization of the dogfish and mussel as food; (2) the life history of the sea mussel. (*Salaried investigator.*)

A. J. Goldfarb, graduate student in Columbia University: the influence of the nervous system upon the regeneration of various organisms.

Charles W. Hargitt, Ph.D., professor of zoology, Syracuse University: the morphology and taxonomy of local cœlenterates. (*Salaried investigator.*)

George T. Hargitt, A.M., Austin teaching fellow, Harvard University: the embryology of hydromedusæ.

George W. Heimrod, Ph.D., assistant in Rockefeller Institute of Medical Research: (1) studies of the enzymes found in marine organisms; (2) preparation of the flesh of fishes for future analysis.

Edwin Linton, Ph.D., professor of biology, Washington and Jefferson College: the helminth parasites of fishes. (*Salaried investigator.*)

Samuel O. Mast, Ph.D., Johnston research scholar, Johns Hopkins University:[3] the reactions of certain marine organisms to light. (*Scientific assistant.*)

James W. Mavor, graduate student, Harvard University: the development of the coral, *Agaricia fragilis*.

Jesse F. McClendon, Ph.D., instructor in zoology, University of Missouri: the chemistry of the echinoderm egg. (*Scientific assistant.*)

William J. Moenkhaus, Ph.D., professor of physiology, University of Indiana: the development of certain fish eggs, after fertilization with spermatozoa from other species or genera. (*Salaried investigator.*)

R. C. Mullenix, Ph.D., professor of biology, Yankton College: the development of the neurofibrillæ in the eighth cranial nerve of *Fundulus heteroclitus*.

Raymond C. Osburn, Ph.D., instructor in zoology, Barnard College, Columbia University: a systematic study of the bryozoa of the Atlantic Coast. (*Salaried investigator.*)

George H. Parker, Ph.D., professor of zoology, Harvard University: (1) the sensory reactions of the dogfish; (2) tests of the hearing of various fishes. (*Salaried investigator.*)

Fernandus Payne, graduate student, Columbia University: studies of chromosomes.

Henry F. Perkins, Ph.D., assistant professor of zoology, University of Vermont, spent a few days in quest of early stages of *Gonionemus*.

Alice Robertson, Ph.D., instructor in zoology, Wellesley College: identification and classification of bryozoa collected by the steamer *Albatross*, in the northwest Pacific in 1906.

A. P. Romine, instructor in biology, State Normal School, Bellingham, Wash.: a study of local crabs.

George G. Scott, A.M., instructor in the College of the City of New York: changes in the specific gravity of the blood of fishes, resulting from changes in the density of the water. (*Scientific assistant.*)

R. W. Sharpe, M.Sc., instructor in biology, DeWitt Clinton High School, New York City: systematic studies of marine entomostraca.

Ralph E. Sheldon, Ph.D., assistant in anatomy, Chicago University: the reactions of fishes to chemical stimuli. (*Scientific assistant.*)

Bertram G. Smith, instructor in zoology, Syracuse University: the embryology of *Cryptobranchus*.

Francis B. Sumner, Ph.D., director of the laboratory: (1) report upon the biological survey; (2) studies of the ecology of the native periwinkle, *Litorina palliata* (with Jas. W. Underwood).

[3] Now instructor in the Woman's College of Baltimore.

James W. Underwood, teacher of biology, high school, Negaunee, Mich.: color variation and other features of the natural history of *Litorina palliata*. (*Scientific assistant.*)

Donald D. Van Slyke, Ph.D., assistant in Rockefeller Institute for Medical Research: the action of enzymes.

Edward M. Weyer, Ph.D., professor of philosophy, Washington and Jefferson College: the behavior of the remora.

The facilities of the laboratory have likewise been utilized to a considerable extent during the months not comprised in the regular summer session. Dr. B. M. Davis and Mr. George T. Hargitt occupied tables during the spring of 1908, and Dr. Davis has enjoyed the privileges of the laboratory throughout the entire winter of 1908–9. For the past three years the director has resided almost continuously at Woods Hole, occupied primarily with the report upon the biological survey. In the compilation of this report he has been assisted, first by Mr. J. W. Underwood and later by Miss E. M. Chapman. From time to time requests have been received from investigators at various institutions for materials for embryological or other studies, or specimens of marine plants and animals. Some of these persons have come to Woods Hole for this purpose. While it is far from the policy of the bureau to operate a supply department for the free distribution of marine specimens, such requests for materials have in special cases been granted. In general it may be said that the demand for a marine laboratory which shall be operated continuously throughout the entire year is increasing, and it is the frequently expressed hope of many persons that the Bureau of Fisheries will in time be able to make provision for the maintenance of such a station at Woods Hole.

During a portion of the coming season the director will be relieved of all administrative duties in connection with the laboratory, in order that he may complete several pieces of unfinished work. During this period, Dr. Raymond C. Osburn, of Columbia University, will serve as acting director.

It is requested that applications for laboratory tables shall be submitted at the earliest possible date.

FRANCIS B. SUMNER

WOODS HOLE, MASS.,
April 30, 1909

THE PLANS AND WORK OF THE GEORGE WASHINGTON UNIVERSITY

THE discussions in the public press seem to call for an authoritative statement of the educational work and condition of the University.

1. Prior to 1902, when the present administration assumed charge, there was a day college, with less than a hundred students, and a faculty of eleven professors and teachers. There was also the Corcoran Scientific School, doing undergraduate work in the evening, which was conducted by the professors of the day college. These professors received salaries in the day college ranging from one thousand to eighteen hundred dollars a year, and seventy-five per cent. of the students' fees for the evening work. This arrangement was made between the faculty and the university to prevent any liability on the part of the university for the expenses of the evening college. In this college there was some work given in engineering and architecture. The Law School was conducted by lawyers in practise and judges in service, no one giving his entire time and attention to its management or to teaching. The Medical School was conducted in the same way, by practising physicians, there being no professional teachers employed giving their whole time to the educational work.

2. The first change adopted under the present administration was to discontinue the Corcoran Scientific School, merge it with Columbian College, and require all class-room

work to be done between the hours of nine in the morning and half-past six in the afternoon; the laboratories and libraries to be kept open, with assistants, until ten o'clock. The objects in view were to unite the student body and create a spirit of unity, and place all the college work upon the basis of absolute equality. The entrance requirements were advanced to conform with those of eastern colleges. Part of the work taken by full-day students and all of the work of the part-day students was given in the afternoon between half past four and half past six o'clock, so that the two groups came into class-room association. As the students employed during the day do not have the same time for the preparation of their class work, they were limited to a less number of hours per week. This increased the period within which the half-day students could earn a degree by one or two years. The effect of this change upon the faculty was to put all of the professors on a salary basis, cutting out the fee system. In the faculty there were differences of opinion as to the wisdom of this change.

3. The next change inaugurated was to employ professional teachers in the professional schools. In the Law School, four men, exclusive of the President, are now employed who give their entire time to teaching. They teach by the case method, which requires much time in preparing for class work and trained ability to impart knowledge. This does not displace or in any way discount the excellent work done by lawyers and judges of very high standing who are still conducting work in the school. Its purpose was to establish in the City of Washington a law school of the type prevailing in the best universities, where men who desire the most thorough training in the law would be able to secure it. A full day law course beginning in the morning was established, with fourteen hours work per week required. This was done to attract the students who give all their time to study and desire to have it fully occupied. An afternoon course of ten hours per week is given for students employed through the day. Thus the needs of the two groups of students were met. To the students giving part of their time a less number of hours is required, but the same quality of teaching provided. By increasing their attendance to four years afternoon students may cover the entire work while full day students complete it in three years. The part-day students may receive the Bachelor of Law (B.L.) degree at the end of the third year. This plan has met with hearty approval from students who are serious-minded and desire to secure the best legal education. These changes have raised our standing in the Association of American Law Schools, and enable our graduates to pass successfully the Bar examinations in all the states. Not one graduate last year failed in these examinations.

4. The changes in the Medical School involve practically the same educational problem and were met with the same objections as those in the Law School. The administration advocated the extension of the laboratories and the employment of specially trained men to teach the laboratory courses. This was done and resulted in the employment of four professional teachers on regular salaries to do this work. The expense involved was the increase of the salary list and the expenses in establishing and maintaining the laboratories. Another change was to increase the clinical teaching, first by requiring men in their graduating year to give their full time to the work in order that they might give full time to the clinic. This was afterwards still further advanced by making the school a full day school, so that students would have their whole time both for laboratory and clinical courses. Didactic lectures are still continued and should be, but the laboratory and clinical teaching is essential to a scientific training. The effect of these changes was to decrease the number of students and the income, at the same time increasing the expenses; but it enables us to retain our position in the Association of American Medical Schools, and enables our graduates to take the medical examinations before all State Boards. It gives us a better standing among medical institutions, and

most of all, will, when the plan is thoroughly worked out, give to each student a thorough training that will enable him to take a high position in his profession, and thus give additional reputation for the school.

5. It will be observed that in all these changes there was but one object in view, to improve the educational standards and methods, bringing them as near as our resources would permit for the standards and methods prevailing in the best institutions. We would not claim to have attained all we hope to attain. This is not the fault of the plans but because of the lack of funds to completely carry out the plans in all particulars. The advances made, however, are great and the advantages to the students and the university are manifest. It would be a matter of profound regret to have these new developments abandoned. Washington needs professional schools of the highest type and should have them.

The next change made was to segregate the work done in engineering and architecture from the liberal arts college. The College of Engineering, the division of architecture, were established. This involved some increase in the expenses, but it has added a fine body of over 200 students to the university, thus increasing the income from students' fees. Additional work was provided in purely technical courses, and through the generous gifts of apparatus by friends, a good laboratory in electrical engineering was created, and a beginning made in a mechanical laboratory. In establishing the College of Engineering it was not intended to make a complete polytechnic school, but simply to put in technical courses and allow the students to take about half of their work in the liberal arts college.

The moving cause for this change was to give the young men of Washington an opportunity within their means to prepare themselves for skilled service in the great professions of engineering and architecture. Washington, with few industrial or commercial openings, offers few opportunities for high grade skilled employment to the rising generation. Without university training in these lines, young men stand little chance of succeeding in the states, where the great state universities and privately endowed institutions are training thousands of young men in these lines. That the situation demanded the establishment of these schools is demonstrated by the large body of students from this city who are taking the courses.

7. In the act of congress providing for the organization and a salary scheme for the teachers in the public schools of the District of Columbia it was provided that new appointees to certain positions in the high schools should have a college education, including the subjects of psychology and pedagogy. These requirements shut the doors of these positions to young people in the district who are financially unable to go to colleges outside of the district. This prompted us to put in the division of education. In this division, we have a professor of psychology, a professor of education, and two lecturers upon school administration. It is not claimed that this is a rounded teachers' college, but it does give, by very competent teachers, the courses required by the act of congress, which, taken in connection with the course for the bachelor of arts degree in the College of Liberal Arts enables the graduate and holder of a teacher's diploma to secure the highest positions in the public school system. These technical courses are substantially taken care of by the tuition fees of the students taking the courses. These fees do not cover the whole expense of the education of the student, for the great body of the work is taken in the College of Liberal Arts. We assumed that if the tuitions would meet the expense of the technical work, we should add to the numbers taking the liberal arts course, meet a pressing demand and serve our city in advanced education of teachers for the public schools.

8. The College of the Political Sciences is the outgrowth of the old school of jurisprudence and diplomacy. Every scholar in this field recognizes that there are peculiar advantages for carrying on this work in the city of Washington and that the effect upon students

living for a time in this city and observing the powers of the federal government in action is most beneficial to the country at large. This college has received special contributions towards its current expenses. During the present year it received ten thousand dollars pledged for next year. We have limited the scope of the work to two years of undergraduate and two of graduate study, making the entrance requirement two years of college work. This brings all students, for the first two years, into the Liberal Arts College, but allows them free election of the courses in the political sciences in the third and fourth years of their undergraduate studies. The object in making it a separate organization was to secure contributions and endowment for the work which could not be done successfully if it was merged in a college of the liberal arts. Experience in other institutions has shown that a faculty of the political sciences is more successful when conducting the work within its own field.

9. It will be observed that all of these small branches that have put out from the main college are confined entirely to technical courses and are intended to furnish the minimum amount of such courses required to meet existing demands in the District of Columbia. The center of it all is the College of Liberal Arts, and in each of these special branches the new students have increased the numbers in the Liberal Arts College, while their tuition fees have nearly paid the salaries of the technical teachers, except in the College of the Political Sciences, and there the deficiency has been made up by special contributions.

10. In order to carry out these plans and do the work on the lines proposed, it has been necessary to fit up and maintain new laboratories and to increase the library facilities. In 1902 we had five or six thousand volumes of books in the whole institution; to-day we have about forty thousand volumes.

11. The foregoing constitutes all of the policies of the present administration which have been criticized or condemned by members of the college faculty and I put them forth without argument, in order that the people of Washington may determine whether these plans have been educationally sound, and whether or not a university serving the community in all of its needs is worthy of their confidence and support. Professors who opposed these educational advances, finding that there was call for efforts to maintain the university, went to the trustees and proposed to take the university and run it for the fees, provided the president was removed and their policies could prevail.

Had this concerted effort been successful with the trustees, not only would the "salary of the president" have been saved, but this new work would have been stricken down and many of the new professors would have been discharged. It is a matter of conjecture whether, had this plan succeeded and fifteen or twenty professors been discharged, there would have been a proportionate increase in the agitation of the public mind.

13. In regard to the pensioning of teachers, so far as I understand it, it has always been construed where a pension system existed that when a professor has become entitled to a pension, either by length of service or by age limit, he has the right to retire voluntarily at any time, and the university has the equal right to retire him when for any cause it seems expedient to do so. In the recent action it became necessary to reduce the expenses about twenty-five thousand dollars, and to distribute that retrenchment among each of the departments of the university. Of necessity the services of some of the teachers had to be dispensed with, and in selecting the ones to be retained, all things being equal, it was natural to retain those who were thoroughly in harmony with the general plans and development of the university.

The action of the Carnegie Foundation in assuming that the university had no option but could retire only those eligible who voluntarily sought retirement seems to be contrary to the usual construction of pension systems. Waiving this point, however, their action in our case was hasty and arbitrary. As the secretary sought to give the widest possible publicity to the injury done the university by

giving their letter to the press, I give my letter in reply, which states the facts regarding the procedure. It reads as follows:

June 11, 1909.

DR. HENRY S. PRITCHETT, *President*,

The Carnegie Foundation for the Advancement of Teaching.

Dear Sir: Your letter of June fourth was received while we were in the midst of Commencement week, and for that reason the answer has been delayed. Immediately upon the receipt of your communication it was presented to a special meeting of the Board of Trustees.

It is a matter of sincere regret on the part of every one who has read the letter that your organization, with its high aims for the advancement of all true efforts in educational work, should have taken this action without any notice to the university and without giving it any opportunity to be heard upon the real and apparent reason for your action, as shown by your letter. That an institution of learning, with fifteen hundred students, should be struck such a blow without warning or opportunity to correct any defects in its administration that might be shown, is difficult to comprehend, and as expressed by others than myself, almost impossible to believe. Your agent arrived here on Wednesday morning, the second instant, and was shown every courtesy that could be accorded to him. Our deans, who have the immediate charge of the educational work, although in the midst of examinations, gave up their time and showed him every consideration. At the end of the examination he came to my office and expressed in the most hearty and gentlemanly way his appreciation of the attention that had been shown him by the secretary of the university and by the deans. I asked him to make any criticisms that he desired to make to me, and assured him that we should be glad to correct any defects in our system that could be corrected. He made a few remarks regarding some of the work, part of them complimentary and part in friendly criticism, but there was no intimation that it was contemplated, or that the investigation was with a view to terminating the relation between the foundation and this university. Since the action has been taken it has been stated by Dr. Sterrett that the agent spent two hours with him and part of the time with Dr. Gore regarding the matter of their retirement. What they said of course I do not know. Had there been a fair investigation of that question with a view to your taking action regarding it, I respectfully submit that the other side of the question should have been heard. To assume that there is but one side to an issue is not only unfair but tends to create the impression that it is desired to hear only one side.

* * * * * * *

Since coming here in 1902 I have had but one aim, and that is to gradually make the institution a true university, serving this community in all possible lines of higher education—a community that has pressing needs for such advantages.

From my acquaintance with you I can but believe that upon mature reflection you will see the injustice that has been done, and will accord a hearing to the university.

With very great respect, I am,

Sincerely yours,

CHARLES W. NEEDHAM

15. In reference to the financial conditions of the university, the treasurer has handed me a comparative statement of the assets of the university in 1900 and the assets at the close of the fiscal year 1908, which shows that in 1900 the gross assets of the university, including everything, were $905,279.45 and the liabilities were $325,719.61, leaving the net assets $579.559.84. In 1908 the total assets were $1,365,503.22, the liabilities $489,004.24, leaving the net assets $876,498.98. The increase in the indebtedness during the last period was occasioned by the completion of the new Medical School building and the Hospital in 1901–2, and indebtedness created to meet deficiencies in current expenses.

Of the foregoing assets the productive investments in 1900 were $223,509.65. In 1908 they were $127,740.91. This change in the productive assets was caused by the drain upon the funds occasioned by the increase in the cost of maintaining the university. The contributions toward the current expenses were insufficient to meet the annual deficit, and thus funds, which were properly applicable, had to be used to pay the salaries and current expenses or close the doors to progress.

It must be borne in mind that the university has always had a deficit. Its productive funds have never been sufficient to meet its expenses. In round figures $125,000 of the

indebtedness in 1900 represented borrowed money to pay accumulated deficits. Since the new policy went into effect the annual deficits have necessarily been larger than they were before, and have been incurred with the authority of the board of trustees, in the belief that the improvement of the educational standards and work, with the increased numbers of students coming in upon higher entrance requirements would so demonstrate the needs of such a university in this district that broad-minded and beneficent men would come to its aid and support the movement. It had been demonstrated by numerous efforts that no money could be obtained for the old university.

We need to secure for the expenses next year, 1909–10, $55,000 to keep the university going on its present plans. This budget has been approved by the board, and if the money is not provided it will again have to be paid out of existing assets. It is apparent that this process of meeting annual deficits out of the assets can not go on very long. The university must have financial support. If congress will give to the District of Columbia the same consideration that it gives to every state and territory and Hawaii and Porto Rico, by extending the benefits of the Morrill act to this district, and designating this university to receive the money, the appropriation would pay a little over one half of the deficit next year. We are doing the work required under the Morrill act in the mechanic arts to justly entitle us to the benefits of this fund. There is no other institution in the district that is carrying on work of university grade in the mechanic arts. If the citizens of the District of Columbia will do as Baltimore did for Johns Hopkins when it was in financial straits and what has been done in other cities for other institutions, raise by subscription a fund of $200,000, payable in five annual installments of $40,000 each, this, with the benefits of the Morrill act, would enable the university to go forward on its present plans and do its work for the district. With five years free from financial anxiety we could hope to thoroughly establish the university upon its new basis, by appeals to the country at large for adequate endowment.

CHARLES W. NEEDHAM,
President

THE GEORGE WASHINGTON UNIVERSITY,
WASHINGTON, D. C., June 21, 1909

PRESENTATION OF A BUST OF DARWIN

At the Darwin celebration held in Cambridge, England, from June 22 to 24, a bronze replica of the bust of Darwin, by Mr. William Couper, which was presented by the New York Academy of Sciences to the American Museum of Natural History in February last, was presented to Christ's College by the American delegates on behalf of those who recognize the influence of Darwin on American thought and science. A letter recently received from Professor Shipley states that the acceptance of this bust would take place at the time of the garden party on June 23.

The American institutions and individuals that have voluntarily contributed towards defraying the expense of this gift, its transportation and its erection in Cambridge (about $1,000) are as follows:

Ann Arbor—Research Club of University of Michigan.

Cambridge—Dr. Alexander Agassiz, Dr. Theobald Smith.

Chicago—University of Chicago.

Cold Spring Harbor, L. I.—Dr. Charles B. Davenport.

Ithaca—Cornell University.

New Haven—Connecticut Academy of Arts and Sciences, Professor Tracey Peck, Professor Russell H. Chittenden.

New York—Columbia University, Dr. E. B. Wilson, Professor Henry Fairfield Osborn, Mr. Charles F. Cox, Mr. M. Taylor Pyne, The American Museum of Natural History, Dr. Hermon C. Bumpus, Brooklyn Institute of Arts and Sciences.

Pasadena—Dr. George E. Hale.

Philadelphia—University of Pennsylvania, Philadelphia Academy of Natural Sciences.

Pittsburgh—Carnegie Institute.

Princeton—Princeton University, Professor W. B. Scott, Professor O. W. Richardson.

Washington—Smithsonian Institution, Dr. Robert S. Woodward, Washington Academy of Sciences.

SCIENTIFIC NOTES AND NEWS

DR. WILLIAM H. WELCH, professor of pathology in the Johns Hopkins University, has been elected president of the American Medical Association.

PROFESSOR E. W. MORLEY has been elected honorary president and Dr. W. H. Nichols acting president of the Seventh International Congress of Applied Chemistry, which has accepted the invitation extended by the congress through the president and the secretary of state, to meet in this country in 1912.

MR. ORVILLE WRIGHT and Mr. Wilbur Wright were presented on June 19 with the gold medal authorized by congress, a medal on behalf of the state of Ohio and a medal on behalf of the city of Dayton.

GOVERNOR SLOAN, of Arizona, has appointed, as territorial geologist, William P. Blake, Sc.D., emeritus professor of geology in the University of Arizona.

PROFESSOR F. W. PUTNAM has been appointed professor emeritus of anthropology in the University of California.

THE University of Pennsylvania has conferred its doctorate of laws on Dr. Charles B. Penrose, formerly professor of gynecology at the university.

BROWN UNIVERSITY has conferred its doctorate of science on Dr. C. V. Chapin, professor in the Harvard Medical School and superintendent of public health in Providence; on Mr. J. B. F. Herreshoff, the chemist of New York City, and on Dr. W. C. Gorgas, of the Isthmian Canal Commission. Dr. Gorgas has also received the doctorate of laws from Jefferson Medical College.

DR. GEORGE E. MACLEAN, president of the Iowa State University, gave the commencement address at Syracuse University and the degree of doctor of laws was conferred on him.

THE University of Glasgow has conferred its doctorate of laws on Dr. C. S. Sherrington, professor of physiology at Liverpool and on Mr. W. H. Maw, editor of *Engineering*.

THE senate of the University of Michigan has presented Dr. Angell with an address engrossed in parchment and bound in silver covers with symbolic designs.

A COMMITTEE has been formed in Dublin to present Professor Fraser with some token of respect on the completion of his twenty-five years as professor of anatomy in the school of the Royal College of Surgeons in Ireland.

DR. ANDREW WALKER MCALESTER, professor of surgery and dean of the School of Medicine of the University of Missouri, has resigned from the faculty of the school with which he has been connected since 1873.

PROFESSOR JOHN CLELLAND, of the University of Glasgow, who has held the chair of anatomy since 1877, and Professor William Jack, who has held the chair of mathematics in the same institution since 1879, are about to retire from active service.

DR. W. P. MASON, professor of chemistry in the Rensselaer Polytechnic Institute, has been elected president of the American Waterworks Association for the meeting to be held next year in New Orleans.

THE Harben gold medal for eminent services to the public health, has been awarded to Professor E. von Behring, of Marburg, and Lieutenant-Colonel W. B. Leishman, professor of pathology, Royal Army Medical College, has been appointed the Harben lecturer for the year 1910, and Professor Angelo Celli, of Rome, the Harben lecturer for the year 1911. The Harben lectures for 1909 were delivered by Professor R. Pfeiffer, of Breslau, on June 21, 23 and 25.

LIEUTENANT EDWARD H. SHACKLETON arrived in England on June 10. He will address a meeting of the Royal Geographical Society at the Albert Hall on June 28, when the special gold medal of the society will be presented to him by the Prince of Wales. At a luncheon given in his honor at the Royal Geographical Society on June 15, Lieutenant Shackleton announced that he contemplated another Antarctic expedition at an early date.

A CABLEGRAM to the daily papers states that Professor T. C. Chamberlin, Dr. E. D.

Chamberlin and Mr. R. T. Burton have returned to Pekin, after investigations on behalf of the University of Chicago, of China's material and intellectual resources and the possibility of American cooperation in developing education in China.

During the present season the Oklahoma Geological Survey will carry on two lines of investigation. Professor D. W. Ohern will have charge of a party in the oil fields in the northeastern part of the state, investigating the occurrence of clay, cement rock, building stone and other structural material in that region. Mr. L. L. Hutchinson, assistant director of the survey, will have charge of investigations on asphalt in southern Oklahoma.

President Whitney has appointed the following committee to represent the American Chemical Society in connection with the Hudson-Fulton celebration: M. T. Bogert, *Chairman*, New York; L. H. Baekeland, Yonkers; W. G. Tucker, Albany; M. A. Hunter, Troy; Edward Ellery, Schenectady.

Mr. Wilfred H. Osgood, of the U. S. Biological Survey, has accepted a position as assistant curator of mammalogy and ornithology in the Field Museum of Natural History of Chicago and will take up his new duties on July 1.

Dr. S. A. Barrett has been appointed to the curatorship of anthropology of the historical department of the Public Museum of the city of Milwaukee. An addition to the building, covering about 19,000 square feet and four stories in height, exclusive of basement which will contain a large lecture hall and assembly rooms, is now being erected.

Mr. Willis L. Moore, chief of the Weather Bureau, is at present in England.

Dr. H. D. Reed, assistant professor of neurology and vertebrate zoology in Cornell University, will leave this country on July 22 for study in Europe. He will be absent about a year and a half. Six months of this time will be spent at the Naples Marine Laboratory and a year at Freiburg.

Mr. L. C. Snider, A.M., University of Indiana, who was recently elected to a position of chemist of the Oklahoma Geological Survey, will spend the summer at the United States Geological Survey testing laboratories at Pittsburg, Pa., conducting a series of tests on Oklahoma clays.

Mrs. Ellen H. Richards, of the Massachusetts Institute of Technology, who is to preside at Denver at the sessions of American Home Economic Association, is to deliver an address before the Western Association of Technical Chemists and Metallurgists on "The two modern dragons—bad air and dust." From there she will go to the University of California to deliver two courses of lectures on euthenics and sanitation.

A portrait of the late George Chapman Caldwell, professor of chemistry at Cornell University, has been painted, for presentation to the university by his colleagues and former students. Dr. Andrew D. White made the presentation address and Dean Crane received the portrait on behalf of the university.

A monument in honor of the eminent surgeon Mikulicz, who died in 1905, has been unveiled in Breslau with an address by his successor Professor Küttner.

At a meeting of subscribers to the statue of Lord Kelvin for Belfast, held on June 2, it was resolved unanimously that the statue be erected in the grounds of the city hall instead of in the grounds of Queen's University.

The twenty-sixth annual convention of the American Institute of Electrical Engineers will be held at Frontenac, Thousand Islands, N. Y., from June 28 to July 1, under the presidency of Mr. Louis Ferguson, of Chicago.

The people of Honolulu already have pledged half of the money asked for by the Massachusetts Institute of Technology for the maintenance of an observatory which the institute proposes to establish at the Brink of Kilauea for the study of volcanic action. Professor T. A. Jaggar will spend the summer there.

The department of geology at the University of Michigan has received from Professor Dean C. Worcester, Secretary of the Interior

for the Philippine Islands and at one time a member of the faculty of the university at Ann Arbor, the gift of a unique collection of photographs of the volcanoes in the Philippine Islands. These excellent photographs, more than two hundred in number, have been taken mainly by Professor Worcester himself in connection with his many journeys through the islands, and for the most part are of volcanoes which have never before been photographed. Among them are a considerable number of prints of a volcano 1,600 feet in height, which in 1871 was suddenly thrown up over a fissure in a level plain only 400 yards distant from the town of Catarman on the Island of Camiguin, north of Mindanao.

MR. ZACCHEUS DANIEL, of the Princeton Observatory, discovered a comet June $15^d.80$ Greenwich mean time, in R. A. $1^h\ 39^m\ 54^s$, Dec. $+28°\ 55'$. The comet is visible in a small telescope. "Motion rapidly northerly."

DR. EDWIN B. FROST, director of the Yerkes Observatory and managing editor of the *Astrophysical Journal*, announces that the subscription price of the journal has been increased from four to five dollars. He writes: "It is obvious that a periodical of a strictly scientific character like the *Astrophysical Journal*, even though conducted without expense for contributions or for editorial or clerical assistance, can not be self-supporting. The large number of costly illustrations, which are necessary to properly elucidate the text and to place before the reader as nearly as possible the author's original scientific evidence, constitute a large item of expense, which has been increased very materially of late by concerted action of engravers. The considerable amount of tabular matter accompanying many of the articles also adds largely to the cost. In spite of the use of monotype composition for much of the text, the cost of manufacture has been gradually increasing, in accordance with the general tendency toward higher prices. The point has been reached where a reduction in the size of the journal and in the average number of illustrations must be made, or the subscription price be increased. The annual deficit of the journal has been met by a subsidy from the University of Chicago, which in the last two years has been $2,000. An increase in this subsidy can not be requested. With the advance in subscription price it is expected that the size of the journal and the number of illustrations will be maintained as during recent years. A careful comparison, in respect to amount of text and illustrations, has been made with all the principal contemporaries of the *Astrophysical Journal*, both foreign and domestic. This shows that even after the present advance, the journal will be relatively cheaper than other periodicals of its class."

AN investigation as to the practicability of reforesting the great areas of forest lands which have been devastated by fire and which are now lying barren and unproductive is now being carried on by the United States Forest Service in the Olympic National Forest in Washington. The area selected for the experiments comprises several thousand acres on the Soleduck River, and was at one time covered with a magnificent forest of Douglas fir. It was first burned over in 1890 and again in 1895. A third fire over almost the same area occurred in 1906, destroying the last remnant of the original forest, leaving the entire area treeless. In some regions a second growth of trees will come in naturally after a burn, in the course of a few years time, and where this happens artificial means of securing reproduction is not necessary. There are, however, other burns, where new growth does not come in readily, due to the adverse climatic conditions, absence of seed trees, or perhaps to the impoverishment of the soil by repeated fires. These areas are often of very large extent and in such cases some means, such as planting trees or sowing seed, is necessary to restore the forest. The burn in the Olympic Forest is of this nature and the Forest Service is planning to conduct a series of experiments to determine the proper methods of reforesting the area. Douglas fir will be the species used. It is believed that on the greater part of the area simply scattering the seed over the ground in the fall before the

snow falls or in the early spring will be sufficient to start a new growth. On other portions of the area, however, where a growth of grass and weeds has covered the ground, it will probably be necessary to work the seed into the soil by raking or dragging brush over the ground. In some localities sowing by what is called the seed spot method in which several seeds are dropped together in spots and covered with soil will probably be successful. To test these various methods five experimental plots have been selected. These represent the various conditions found on the burn, such as difference in slope, altitude, exposure and vegetation. This fall a large quantity of Douglas fir seed will be collected and a quantity sown on each plot. Next spring the experiments will be repeated and it is expected that the results obtained will indicate what methods and what seasons of the year are best adapted to the conditions found on this burn. When this is accomplished the Forest Service will be in a position to commence the reforestation of the Soleduck burn on a large scale and to reseed large areas each year. It is believed also that the results obtained will be of value not only in solving the problem of restocking the burn in the Olympic National Forest, but that much will be learned concerning the best methods of reforesting denuded areas in other forests throughout the Pacific northwest, where conditions are similar, and that thus the work may be largely extended.

UNIVERSITY AND EDUCATIONAL NEWS

THE University of Wisconsin, the University of Michigan, the University of Minnesota and the University of Toronto have been admitted to the regular pension system of the Carnegie Foundation for the Advancement of Teaching.

MR. JOHN D. ARCHBOLD has given $300,000 to Syracuse University, to pay the mortgage on the ground of the university which was placed in order to build the gymnasium.

SWARTHMORE COLLEGE will receive $125,000 from the General Educational Board, providing the sum of $375,000 is raised within two years by the college. The sum of $187,500 has already been subscribed.

DR. C. T. WILLIAMS, of Pembroke College, has given £2,500 to Oxford University for scholarships in physiology and human anatomy.

THE School of Mining affiliated with Queen's University in Kingston, Ont., is about to erect a new chemical building which will cost nearly one hundred thousand dollars and will probably be ready for occupation in October, 1910. In the meantime, indeed very soon, two or three appointments to the teaching staff will be made. A building for mining and metallurgy will also be put up at a probable cost of fifty thousand dollars. It is the gift of a member of the staff of the school, Professor Nicol, of the department of mineralogy. The chemical building is provided by the Ontario government.

THE department of zoology and geology at the Massachusetts Agricultural College will this year conduct a ten days' camp at the seashore for introductory work in marine zoology. The camp will be established at Groton, Connecticut, at the mouth of the Poquonnock River. Work will begin at the close of the college year. The department thus aims to supplement its courses in general and economic zoology. The work will consist mainly in the study of habits, habitats and ecological problems, in collecting for study, dissection and preservation and in photographic work. The privileges of the excursion are open to students of elective undergraduate courses. Reports will be required and credit will be given for the work as a part of the undergraduate courses. The work will be in charge of Professor C. E. Gordon.

THE Rev. Henry H. Appel, of York, has been elected president of Franklin and Marshall College, at Lancaster, Pa. Mr. Appel is a son of the late Thomas G. Appel, who was president of the college for many years.

DR. HAROLD PENDER, of New York City, has been appointed professor of electrical engineering in the Massachusetts Institute of Technology.

OSCAR A. JOHANNSEN, assistant professor of civil engineering at Cornell University and author of researches on the biology of water supply, has accepted the professorship of entomology in the University of Maine.

DR. J. E. KIRKWOOD, formerly an investigator with the Continental-Mexican Rubber Company in Mexico, has been appointed assistant professor of forestry and botany in the University of Montana.

CHAS. H. TAYLOR, a graduate student in geology at the University of Chicago, has been appointed assistant professor of geology in the University of Oklahoma.

PROFESSOR H. A. WILSON, F.R.S., of King's College, London, has accepted the appointment of professor of physics in McGill University.

DR. ARTHUR LAPWORTH has been appointed a senior lecturer in chemistry at the University of Manchester. He is the son of Dr. Lapworth, F.R.S., professor of geology at Birmingham, and is at present head of the chemical department of the Goldsmiths' Institute, New-cross.

DISCUSSION AND CORRESPONDENCE

MYLOSTOMID DENTAL PLATES

IN a recent contribution by Dr. L. Hussakof on "Relationships of American Arthrodires" (*Bull. Amer. Mus. Nat. Hist.*, 26, art. 20), a peculiar dental element is made known under the caption of *Dinognathus ferox*. The designation applies to a supposed new genus and species of Arthrodires, of doubtful family relations, and whose characters are imperfectly definable. The position of the plate in the mouth is held to be indeterminate, although remark is made that "its form is not suggestive of having been set in a titanichthid mandible."

Knowledge of this unique structure is the more welcome, since, as the present writer believes, it dispels the mystery of the missing upper dentition of *Mylostoma terrelli* Newb. That the peculiar plate in question belongs to the same sort of creature, if not indeed to the identical species as that established by Newberry upon the evidence of a solitary mandibular plate (now the property of the Museum of Comparative Zoology), seems practically certain. At all events it can be provisionally associated with the type of *M. terrelli* with the same confidence that actuated Newberry's theoretical correlation of upper and lower dental plates of *M. variabile*—an hypothesis afterwards confirmed beyond peradventure by Bashford Dean.

The mylostomid nature of the novel dental plate under discussion is unmistakable, one might even say self-evident, the moment it is perceived to be a compound instead of simple element, representing in its entirety the forwardly placed pair of palato-pterygoid dental plates common to Arthrodires and Ctenodipterines. Among the latter, *Heliodus lesleyi* furnishes an analogous instance of fusion of the corresponding parts.

The newly discovered dental plate is significant for yet another reason, namely, for enlightening us as to the extent to which the components of the upper dentition of Arthrodires are capable of fusion *inter se*. Certainly in *Dinomylostoma*, and presumably, also, in *Mylostoma* proper, there is a single pair of vomerine, and two distinct pairs of palatopterygoid dental plates. In Dinichthyids, so far as known, the two last-named pairs on either side are fused into a single "maxillary" element or "shear-tooth." *Dinognathus* is peculiar in having the forward pair of palatopterygoid tritors fused into a single plate, whose periphery accords fairly well with the antero-external contour of the mandible—that is, on the assumption that Newberry's so-called *M. terrelli* and the newly described *Dinognathus ferox* relate merely to different parts of the same dental apparatus. It is pertinent to observe further that a rounded eminence occurs in the median line anteriorly, as shown in Dr. Hussakof's figure, corresponding in size and position to surface elevations of the homologous plates in *M. variabile*. The manner in which these eminences interact with depressions in the functional surface of the lower dentition has been discussed elsewhere. As to the occurrence of vomerine teeth and a

posterior pair of palato-pterygoid dental plates in the new genus described by Dr. Hussakof we are still without information, but the presence of the latter, at least, may be predicated as a logical necessity.

Newberry's recognition of *M. terrelli* as a distinct species is justified by appreciable differences between the mandible upon which it was founded and those characterized by him as *M. variabile*. Generic differences between it and other Mylostomids are now indicated by the characters of its (supposed) upper dental pavement. Hence, in order to give effectiveness to the theoretical association of parts here proposed, it becomes necessary first of all to unite the two "species" of *ferox* and *terrelli;* and secondly, to substitute the latter specific title, on grounds of priority, as genotype of *Dinognathus*.

C. R. Eastman
Harvard University

A LAWYER ON THE NOMENCLATURE QUESTION

Discussions of the past year or two in scientific journals—more particularly in Science—move the undersigned to free his mind on the above subject. Trained first as a zoologist and later as a lawyer, he now follows law as his vocation and zoology as his avocation. This is a good combination of schoolings for the appreciation of some aspects of the nomenclature question.

In the first place, nomenclature as an art—and it is already an art and a very specialized one at that—is not science at all, but law pure and simple. It is the art of interpreting and applying to various states of natural fact the unnatural man-made rules which have grown up during the last century and a half, partly by unwritten custom, partly by precedents, and partly by conscious legislation, just exactly as other systems of law have grown up. Doubtless it is because the scientific men who handle this body of law have no legal training and try to handle it as if it were science (as some undoubtedly suppose it to be) that they make such a prodigious bungle of it. Their chief blunder is that they endeavor to carry on and administer and build up this system of law *without any courts!* Consequently every piece of litigation (conducted most uneconomically and unsystematically by loose correspondence and articles in scientific journals which ought to be reserved for better things) is indeterminate and each litigant remains of the same opinion still and acts accordingly. If merchants and business men were so stupid as to try to administer the complicated rules of their game for themselves, to the ruinous neglect of their real interests, without special training in the making and interpreting of rules, and *without tribunals for the settlement of their questions,* we should have an exact parallel to the situation which has arisen in zoology and botany.

Some may doubt my dictum that the field of nomenclature is a field of law, not science. Let me add to this dictum one to the effect that many, if not most, of the questions of nomenclature (like many questions of law) are of utterly insignificant importance so only that they be settled *one way or the other, quickly, definitely* and *permanently*. Then let me cite an instance—and a fair one too—illustrative of both dicta.

Picking up the April number of the *Proceedings of the Malacological Society of London,* I see that A. J. Jukes-Brown, a competent authority in the malacological world, differs widely and strenuously, though courteously, from our own Dr. Dall (a highly competent authority) as to the nomenclature of certain groups of the Veneridæ. In part his difference turns on different findings and interpretations of facts. These are scientific differences. The scientific methods of which each is master will enable the two men to agree—or if they can not reach the same conclusion then to agree to differ. Neither can, or should, after his final reexamination of the evidence, yield his honest opinion a jot to anybody or to any tribunal. But in part his difference turns on the following point. Dr. Paul Fischer, in his "Manuel de Conchyliologie" (etc.), did much rearranging and collating of generic and subgeneric groups. For each group he had the habit of naming one species with the prefix "*ex.*," standing, of course, for "example." Dr. Dall, perhaps not

unnaturally considering it as of little significance whether the species selected as illustrative of a group was called "the type" or "the example" of it, regarded Fischer in these cases as having designated the type with the usual train of consequences under the rules. Jukes-Brown holds that of course Fischer did nothing of the kind, examples not necessarily being types.

I should be willing to argue either side of this if paid for it—but not otherwise! It is a law-point pure and simple and a dry one at that. It is not of the very smallest import to any aspect of science which way it is decided. To flip a coin would be a good way to settle it. Yet in the present state of things it is quite supposable that Dr. Dall and Mr. Jukes-Brown, in order to reach a working agreement as to the nomenclature of the Veneridæ which *is* of scientific import, may feel compelled to give considerable amounts of their time, and considerable space in a crowded journal, to a necessarily inconclusive attempt to thresh it out.

It is a sin and a shame, a reproach to science and scientific men, that the time of master specialists, every available moment of which is needed by science, should be taken up by utterly vain questions like this, which any whipper-snapper just out of a law school could actually handle better than they can because trained for it and not taking it so much in earnest. And their time *is* taken up by questions like this, and it *has* to be under the present lack of system.

And what, pray, is the great difficulty in settling these things as they should be settled? If the next International Zoological Congress voted to establish an international court of five members sitting for three months annually to decide in writing every question submitted, with or without argument, taking counsel with specialists when necessary, publishing its decisions in an annual volume with or without the course of reasoning in each case, how many years would it take before the *main* questions were *all settled* and the business of the court reduced to a thin trickle of new puzzles? Of course such a court should have absolute power to settle absolutely everything nomenclatorial except questions of natural fact and scientific interpretation. Equally of course it would have to treat the priority rule as a *prima facie* rule made by sane men for sane men, not as the superstition and incubus it has become. If they saw fit to rule *in* one auction catalogue as a nomenclatorial source for merely practical reasons, and rule *out* another for similar reasons, they should have a free hand to do so without feeling that any one by being the first to name, or perhaps mis-name, a natural object thereby acquired a vested right to retard the progress of science for centuries. Of course in the present absence of such a tribunal, or of *any* tribunal, an absolute priority rule has an excuse as being the nearest present approach to a universal touchstone for our names, and so long as that situation endures systematists are bound to live strictly up to it. But with such a tribunal suggested the direful necessity for it would pass away, and the "Museum Smithianum," 1832, having once been ruled in we could then apply its names and learn them without the probability of someone's discovering next year that the "Museum Jonesianum"—date hitherto unknown—was in fact published in 1831. Nay more, a discovery that the "Museum Smithianum" was a rank forgery and in large part non-binomial need not worry us. Once ruled in or out, mistakenly or not, it stays so. The name "*Octopus*" once adjudicated to be the name of the group typified by *O. vulgaris* L. stays so no matter how clear the proof that the court ought by every known rule to have made it "*Polypus*." Is there any ethical question involved? No. And does it matter to science which it is called? Not an iota so long as we know which.

Would it not tend to "crystallize" and "fossilize" science? No, but it would tend to crystallize and fossilize the artificial Latin nomenclature of science which *ought* to be crystallized and fossilized, and the sooner the better. Of course no tribunal can ever pass on the question whether a given form is a variety, a subspecies or a species; whether it belongs to this or to that genus or subgenus; what are the limits of a family; *nor on any*

other question of science properly so called. And equally of course nomenclature can never be definitely settled. But its puerile and yet forbidding aspect can be vastly altered for the better.

Is there any real practical difficulty in the way of doing all I have suggested and doing it at once? Emphatically *no*! Men more trained to cooperation than scientific men—business men, administrators, lawyers, politicians—would have done it long ago.

Francis N. Balch

Jamaica Plain,
May 21, 1909

PERSONAL NAMES AND NOMENCLATURE

The use of personal names in nomenclature which has been somewhat criticized by various correspondents is perhaps defensible under certain circumstances. While its objections in many instances have been pointed out yet the absurdity of the practise becomes strikingly apparent when one notes such a paper as that on Paleozoic Ostracods in a recent volume of the Proceedings of the National Museum. In all, sixteen generic names are used in the article; nine of these are old and seven new. Among the old names, five are certainly personal in origin, four may not be, although two of these probably are. Among the seven new names, absolutely every one is personal. Either this indicates an extraordinary number of distinguished men in this field or an unfortunate lack of mental energy on the part of the authors.

X

SIR WILLIAM GAIRDNER'S PAPERS

To the Editor of Science: In response to the wishes of Lady Gairdner and her family, I have undertaken to edit the medical and scientific papers and articles of the late Sir William Tennant Gairdner, and to preface the collection with a biography.

In order to render the work as worthy as possible of the memory of the late professor, I am desirous of enlisting the sympathy and help of his friends. I venture therefore to request through your columns that any one who has in his possession any letters or other literary remains of Sir William Gairdner will be so kind as to communicate with me.

G. A. Gibson

3 Drumsheugh Gardens,
Edinburgh,
May 12, 1909

SCIENTIFIC BOOKS

The Book of Wheat. By Peter Tracy Dondlinger, Ph.D., formerly Professor of Mathematics in Fairmount College. With 60 illustrations. Pp. xi + 369. New York, Orange Judd Company; London, Kegan Paul, Trench, Trübner & Co., Limited. 1908.

When we think of the great importance of the cereal wheat in the food economy of nations it is surprising that there has not been more written on the subject. The book now before us is something that might well have been looked for years ago. The author has furnished portions of his manuscript at different times to the writer of this review, and the latter has, therefore, known something of what was to be expected in the book itself.

Naturally a writer is likely to give more prominence, in discussing a subject, to those features with which he has come most often in daily contact, and so in this instance there is proportionately not as much space given to the discussion of wheat as a plant as to the milling operations, the commercial and economical position, etc. The work is particularly lacking in its presentation of wheat classification, discussion of varieties and other matters of botanical and agronomic interest. On the other hand, there is a very full discussion of the machinery for harvesting and threshing, crop rotations, fertilizers, marketing, milling, prices, movement and consumption. A commendable feature, also, is the addition of a very complete bibliography, though it must be said that the proofreading of this bibliography was very faulty.

Considerable attention is also properly given to the topic of diseases and insect enemies.

In making use of the map (page 9) showing wheat distribution, which was formerly published by the U. S. Department of Agricul-

ture, it is unfortunate that the author did not so change it, in accordance with the suggestion of the writer, as to put the durum wheat district in its correct position. This area, however, is properly shown in another map on page 48. Not long after the publication of the first map by the U. S. Department of Agriculture events occurred in the establishment of durum wheat which greatly changed the boundaries of the district.

Because of the lack of special observation and training in particular lines the author is led into making a few peculiar statements, some of which are not well founded; for example, the statement on page 48: "Common bread wheats are usually grown on black soils. These soils are not well adapted to fall wheat, however, for it is apt to winterkill." There is no good reason for this statement, with the possible exception that black soils are often heavy and therefore apt to bake and crack open, thereby exposing the crown and roots to the winter's cold, but even then rolling the ground is a simple remedy. As a matter of fact, winter wheat is very commonly grown on just such soils.

Also, on page 51, it is not clear why the author should say: "Winter wheat may be sown in spring and spring wheat in the fall. Only a very few plants will ripen seed, but when this is continuously sown, *in three years the spring variety will be changed to the winter, and vice versa.*" (Italics are the reviewers.) There are only certain varieties, already on the border of these two groups, that we are yet certain can be thus changed at all, and even these are likely to require much more than three years to become completely adaptable in the other group.

There is a slight inaccuracy in the first paragraph on page 56, which, however, in this case is rather important, as it refers to the introduction of the present hard winter wheat, called here "red winter wheat," from Russia into Kansas. The Department of Agriculture did not, as there mentioned, originally introduce the wheat, but later took active part in extending the area by further importations; it appears that Russian Mennonites first brought the wheat to Kansas.

On pages 121 and 122, after describing the extensive immigration into the Great Plains region and the rapid settlement of that area, saying: "The 'Great American Desert' disappeared from the maps," and "During a series of years in which the rainfall was more adequate than usual, the agricultural areas leaped forward to the west from county to county," the reader is suddenly brought against a fall of cold water by the statement that "Yet the blunt fact remained, and still remains, that many millions of acres were dead, vacant, and profitless simply because of their aridity. This land has little value now, for in many places a whole section does not yield enough to keep a fleet-footed sheep from starving." Without any question much has been said that is extreme on both sides of this question of just how profitable may be the cultivation of these semiarid lands, but doubtless there is a sane, medium ground to be taken. It is certain that, as a rule, much more may be produced than is sufficient "to keep a fleet-footed sheep from starving," but, on the other hand, the proper cultivation of such districts is in no way child's play. No doubt fair average results can be obtained, but the farming must be done by the most intelligent, up-to-date methods.

Under the discussion of milling operations we have, on page 272, the same old diagram of a large flour mill which has been used in various other publications, but which would not be at all an accurate presentation of our present-day, improved mills.

After these statements of some imperfections, of which it must be admitted there do not seem to be many, the author is to be commended for the ample presentation he makes of certain phases of wheat handling, giving a particularly full discussion of the marketing, price and movement of wheat, including dealings on boards of trade, speculation, grain privileges, delivery, etc. There is considerable discussion, also, of storage, grain elevators, the method of bagging on the Pacific Coast, etc.

The book is rather fully illustrated, particularly along commercial lines. It is a book that will be extremely useful not only to busi-

ness men but as a reference work in schools and colleges. MARK ALFRED CARLETON
U. S. DEPARTMENT OF AGRICULTURE

BOTANICAL NOTES

GENERAL NOTES

ONE of the most interesting of the popular bulletins issued by the United States Department of Agriculture is that on "The Basket Willow" (Farmers' Bulletin 34) prepared by W. F. Hubbard, of the Forest Service. It appears that the growing of basket willows was introduced into the United States about sixty years ago by German immigrants who settled in New York and Pennsylvania. It has now extended south and west and is rapidly spreading over the non-arid regions of the far west. Three species are commonly grown for this purpose, viz., *Salix amygdalina*, *S. purpurea* and *S. pruinosa acutifolia*, and in the bulletin the peculiarities of each are given. How to plant, how to prune and care for the young trees, how to cut and peel the rods, and finally how to prepare them for the market are described in a most interesting manner. Every botanist who is interested in the economic aspects of his science will find this pamphlet worth reading.

Botanists of an ecological turn of mind will find in A. W. Sampson's paper on "The Revegetation of Over-grazed Range Areas" (Circular 158, U. S. Forest Service) an example of how ecology may have some intensely practical applications. In the Wallowa National Forest in northeastern Oregon the sheep owners overgrazed the land, and it became necessary to study the problem of the restoration of the pastures to their original condition. At first this would seem to be an agricultural problem, but its solution called for "an expert in plant ecology (Mr. Sampson) and in the last analysis the problem becomes an ecological one. The paper is commended to ecologists for careful study.

Another agricultural bulletin of high botanical interest is L. H. Smith's on "The Effect of Selection upon Certain Physical Characters of the Corn Plant" (Bull. 132, Ill. Expt. Station) in which are given the results of experiments in breeding corn (maize) with reference to (1) the height of the stalk, and (2) the declination of the ear from the stalk. By starting with a particular variety of corn and breeeding in opposite directions in the fifth generation the average heights of the ears on the stalks are three feet apart. In part this is due to the increased height of the whole plant on one hand, and the decreased height on the other, but it is due still more to the appearance of the ears from higher or lower internodes. Thus the average number of internodes below the high-eared corn was 8½, while the average for the low-eared corn was 6½, and this was reduced to a little more than 4½ in the last generation. Apparently one may breed the ears down to the ground, or up out of reach.

Here may be mentioned W. T. Macoun's "List of Herbaceous Perennials Tested in the Arboretum and Botanic Garden of the Central Experimental Farm at Ottawa, Canada," which contains an astonishingly large number of species (over 2,100), when one thinks of how far north they were grown.

Under the title "The Distribution of Woody Plants in the Pikes Peak Region" Professor E. C. Schneider enumerates 115 species, giving altitudes, distribution and descriptive notes. It is printed in the Colorado College Publication (Vol. XII., Science Series). Fifteen conifers are enumerated, five poplars, fourteen willows, six oaks, etc.

Much more ecological in nature is Professor Ramaley's "Studies in Lake and Streamside Vegetation" (*Univ. Colo. Studies*, Vol. VI.), which deals with the plants of Redrock Lake near Ward, Colo., at an altitude of over 10,000 feet above sea-level. It is, we are told, the first of a series of similar papers. It is beautifully illustrated by many half-tone reproductions of photographs.

That the botanists of Colorado are active is shown by the foregoing, and also by the following titles of recent papers in the *University of Colorado Studies* (Vol. VI.): "Botanical Opportunity in Colorado," by Professor Ramaley; "Studies in Mesa and Foothill Vegetation" (including the "Distribution of Conifers (4 species only) on the Mesas," by

W. W. Robbins and G. S. Dodds, and "Distribution of Deciduous Trees and Shrubs on the Mesas," by W. W. Robbins); and "Bibliography and History of Colorado Botany," by Edith M. Allison. Under the last title several hundred papers are enumerated bearing more or less upon Colorado botany.

Somewhat out of the ordinary is Professor De Loach's bulletin entitled "The Mendelian and De Vriesian Laws Applied to Cotton Breeding" (Bull. 83, Georgia Experiment Station). It is a plea for the application of scientific principles to the breeding of the cotton plant, with illustrations from his own work, and will repay careful reading.

The Report of the State Forester of Wisconsin for 1907 and 1908 contains much interesting, and some encouraging matter for the lover of forests. Especially pleasing is the "half-tone" frontispiece which shows a thrifty growth of young pines which if protected will eventually restock the land with a forest covering.

Not strictly botanical, but worthy of examination, is the Second Biennial Report of the Wyoming State Board of Horticulture, of which the well-known botanist, Professor Aven Nelson, is the secretary. The eastern reader will be astonished at the photographs of fine trees and fruits grown in this new mountain state.

RECENT SYSTEMATIC PAPERS

Another local manual of botany has appeared, this time in a region where such a thing is much needed. Professor J. R. Watson, of the University of New Mexico, has issued as one of the bulletins of the university (No. 49) a pamphlet of a little more than a hundred pages consisting of a "Manual of the More Common Flowering Plants Growing without Cultivation in Bernalillo County, New Mexico." In his preface the author says that it "has grown out of the need of a key to the local plants to place in the hands of his students. None of the manuals published cover this region satisfactorily." Thus finding no systematic manual, he very properly went to work and made one. That is the right spirit for the teacher, and Professor Watson is to be commended for undertaking the work. And we say this in spite of the poor printing and the numerous typographical errors in the pamphlet. One who has had no experience with the small printing establishments to be found away from the large cities has no conception of the impossibility of faultless typography under such circumstances. So we overlook the *form* of the little manual, and see in it a worthy effort of the author to supply a usable book for his pupils. We should like to see more teachers willing to incur the labor necessary to provide as useful a book as this.

H. Leveille's "Monographie du Genre Onothera," begun some years ago, has reached its third part and includes species from No. 38 to 54, *i. e.*, those of the "groups" *Godetia, Clarkia* and *Boisduvalia.*

Recent numbers of the "Leaflets of Philippine Botany" issued at irregular intervals by A. D. E. Elmer, of Manila, include articles 23 (November 23, 1908) to 29 (February 15, 1909). The titles are "Synopsis of *Rubus*" (classifying and describing the sixteen species and one variety which occur on the island), "Threescore of New Plants," "The Genus *Itea*" (containing two Philippine species), "A Fascicle of South Negros Figs" (34 species, of which 5 are new), "Gesneraceæ from the Cuernos Mountains," "New Philippine Zingiberaceæ" and "A Score of New Plants." These "leaflets" constitute an interesting little journal of systematic botany.

A NEW LAKESIDE LABORATORY

A very pretty prospectus announces the establishment of the "Lakeside Laboratory" of the State University of Iowa at Okoboji, Iowa, by the alumni of that institution. The location is on a bay on the westerly side of Okoboji Lake, in the extreme northern part of central Iowa, at the highest elevation above the sea of any place in the state. The session covers ten weeks, divided into two terms, the first from June 21 to July 31, and the second from August 2 to August 28. In botany three courses are offered in the first term, namely: (1) mycology, by Professor Macbride; (2)

biology of aquatic plants, by Professor Wylie; (3) the nature of plants, by Professor Wylie. Opportunities are afforded, also, for research work in botany under the direction of the two professors named. In the second term, work is offered in field ecology and plant taxonomy by Professor Shimek. Courses in geology, zoology and nature study also are offered by competent instructors. The management of this summer-school work is in charge of the director of university extension at Iowa City.

Charles E. Bessey
The University of Nebraska

SPECIAL ARTICLES

SEX AND ITS RELATION TO THE BARRING FACTOR IN POULTRY

W. J. Spillman[1] has suggested that the barring factor and sex in poultry are correlated in such a way that the female is always heterozygous in respect to sex and also barring when present. The male, on the other hand, is always homozygous in respect to sex and may be either homozygous or heterozygous in respect to barring. I have recently performed the following experiments, which bear directly on this point and confirm his theoretical deductions.

Experiment 1.—A Buff Rock male (non-barred) bred to Barred Rock females give, in F_1, barred males and non-barred (blacks or buff) females.

Experiment 2.—A Barred Rock male bred to Buff Rock females (non-barred) or a Rhode Island Red female (non-barred) gives in F_1, all barred birds in both sexes.

Experiment 3.—A Buff Rock male bred to F_1 females (non-barred) from experiment 1 gives, in F_2, chicks which do not show the down pattern characteristic of chicks from barred parents, thus indicating an entire absence of barring in F_2.

These experiments may be formulated thus: Using B = barring factor, b = its absence; F = the female sex factor, f = its absence or the male sex factor. Assume that B and F can not occur in the same gamete (Spillman). Then,

[1] *Am. Nat.*, Vol. XLII., No. 50, 1908.

Experiment 1 becomes $bf \cdot bf \times Bf \cdot bF = Bf \cdot bf + bf \cdot bF$.

Experiment 2 becomes $Bf \cdot Bf \times bf \cdot bF = Bf \cdot bf + Bf \cdot bF$.

Experiment 3 becomes $bf \cdot bf \times bf \cdot bF = bf \cdot bf + bf \cdot bF$.

Other crosses giving similar results are:

Experiment 4.—A White Rock male (carrying barring as a cryptomere) mated with Brown Leghorn females gives in F_1 both sexes barred.

Experiment 5.—The reciprocal cross; viz., a Brown Leghorn male mated with White Rock females gives black chicks and chicks having a down pattern like that of Barred Rock chicks. These chicks, however, are yet too young to enable a determination of their sex.

Experiment 6.—A White Rock male (carrying barring) bred to Buff Rock females gives, in F_1, both sexes barred.

Experiment 7.—From the reciprocal cross I have only two birds as yet, both barred males.

Experiment 8.—One of the F_1 barred males from experiment 7 mated with a Buff Rock female gives, in F_2, barred and non-barred chicks, which are still too young to permit of their sex being determined.

While my results appear to confirm Spillman's suggestion, I wish to point out that experiment 3, rather than experiment 2, 4, 6 or 8, furnishes us the true test of his suggestion, for the reason that the presence of the F factor may simply prevent the B factor from becoming visible under certain conditions. In some experiments, at any rate, I find that the presence of the F factor operates to modify barring, making it appear obscure and blurred as compared with males from the same parents. On the other hand, we may refer this obscuring of barring to some other cause, perhaps the heterozygous nature of the female.

The details of these experiments are reserved for a later paper.

H. D. Goodale

Since the above note went to Science some F_2 chicks in experiment 3, have reached the

stage at which barred chicks usually exhibit distinct barring in their first feathers. Such barring is absent in these F_2 chicks.

THE TENTH ANNUAL MEETING OF THE SOCIETY OF AMERICAN BACTERIOLOGISTS HELD AT BALTIMORE, MD., DECEMBER 29–31, 1908

THE tenth annual meeting of the Society of American Bacteriologists was held in the rooms of the laboratories of pathology and of physiology of the Johns Hopkins University and Hospital, Baltimore, Md., on December 29, 30 and 31, 1908.

Professor H. L. Russell, of the University of Wisconsin, president of the society, occupied the chair.

The scientific program consisted of thirty-two papers, all of which aroused much interest; certain of them are reproduced in abstract below. The society also met in joint session with Section K of the American Association for the Advancement of Science on December 30, when a paper on "Anaphylaxis" was read by one of its members, Dr. M. J. Rosenau, of Washington, D. C.

About fifty-two persons were in daily attendance at the several sessions of the society.

During the sessions the following matters of business were transacted: Dr. William H. Welch, of Baltimore, was reelected to represent the society on the council of the American Association for the Advancement of Science. To fill the vacancy on the Committee on Methods and Identification of Species, caused by the absence of Professor F. D. Chester, Professor C.-E. A. Winslow, of Boston, was duly elected. Professor Erwin F. Smith, of Washington, D. C., was delegated to represent the society at the approaching meetings of the International Botanical Congress at Brussels in 1910. The question of the society withdrawing its affiliation with the American Association for the Advancement of Science and transferring the same to the American Society of Naturalists and agreeing to meet with the latter body in the future was warmly discussed. It was decided to sever the present relations and join meetings with the naturalists should they decide to meet apart from the American Association for the Advancement of Science.

The following are the names of the officers of the society elected for the year 1909:

President—Dr. J. J. Kinyoun, Washington, D. C.

Vice-president—Dr. Veranus A. Moore, Ithaca, N. Y.

Secretary and Treasurer—Dr. N. MacL. Harris, Chicago, Ill.

Council—Dr. W. W. Ford, Baltimore, Md.; Dr. F. C. Harrison, Macdonald College, Quebec; Dr. H. W. Hill, Minneapolis, Minn.; Mr. Lore A. Rogers, Washington, D. C.

By the election of the following gentlemen, the limit to active membership in the society, as defined by the constitution, has now been reached, namely, 125:

Dr. Burdett L. Arms, assistant director of the bacteriological laboratory of the Board of Health, Boston, Mass.

Dr. John W. Connaway, professor of comparative medicine, and veterinarian in the College of Agriculture, the University of Missouri, Columbia, Mo.

Mr. George E. Gage, assistant in bacteriology, Yale University, New Haven, Conn.

Mr. Daniel D. Jackson, director of the laboratories, Department of Water Supply, Gas and Electricity, New York City.

Dr. Harry T. Marshall, professor of pathology and bacteriology, University of Virginia, Charlottesville, Va.

Dr. Otto Rahn, assistant professor of bacteriology and hygiene, Michigan Agricultural College, East Lansing, Mich.

Mr. James C. Temple, soil bacteriologist, Georgia Agricultural Experiment Station, Experiment, Ga.

ABSTRACTS OF CERTAIN PAPERS

Acid Fermentations of Milk: E. G. HASTINGS and B. W. HAMMER, University of Wisconsin, Madison, Wis.

In milk, butter and cheese are constantly found organisms identical in all important points with those supposed to be characteristic of certain fermented milks, especially the Bulgarian yoghurt. Production of 3–4 per cent. of acid in milk, growth at high temperature characterize the organism. The therapeutic value which has been ascribed by Metchnikoff and others to the fermented milks, such as yoghurt, is probably due to the composition of the milk, rather than to the presence of the peculiar organism. Since opportunity is constantly offered for the alimentary tract to become seeded with the organism, if it finds favorable conditions for growth in the alimentary tract, it should establish itself, no matter how slight the seeding may be, and we should find it in the feces constantly. Massive seedings can only temporarily establish the organism unless the environment is favorable.

Some Factors concerned in the Fixation of Nitrogen by Azotobacter: Conrad Hoffmann and B. W. Hammer, Bacteriological Laboratories, University of Wisconsin, Madison, Wis.

The possibility of employing azotobacter for artificial soil inoculation, as well as the importance of its existence in soil as a nitrogen increaser, are factors which can not be ignored. With these as a basis, the work reported in the paper of the above title was performed. It appears that some fermentable carbohydrate is essential for nitrogen fixation; the same is true with reference to the presence of phosphorus and some base. The influence of (1) varying amounts and kinds of carbohydrates; (2) of varying kinds of phosphates (mono-, di and tri-forms), and (3) of the period of incubation, were all factors which were considered. The employment of the sand slope and the large Petrie dish cultures proved most efficient in securing the maximum development of azotobacter in pure culture.

Persistence of Anthrax Spores in Raw Water: E. G. Hastings, University of Wisconsin, Madison, Wis.

Anthrax spores have been found to persist for eight years in raw pond water. The longest period of persistence in raw water noted previously was five months; in sterile distilled water thirty months. The water was infected by tannery refuse and growth of the anthrax bacillus had taken place before or after the sample was taken from a stagnant pond. It would seem that the supposition expressed by many that the anthrax organism can grow in nature is true.

Synthetic Media for the Isolation of B. coli from Water: Maurice L. Dolt, Brown University, Providence, R. I.

It was found possible to grow *B. coli* on one per cent. solutions of asparagin if 0.2 per cent. of sodium or ammonium phosphate is added. No other of the soluble inorganic salts seemed to serve.

Substances having an asymmetric carbon atom in their molecule and a CHOH group, such as glycerin, ammonium lactate, malic acid, can be substituted for the asparagin. These substances seem to favor the growth of the *B. coli* and to inhibit the growth of other water organisms. It is very likely the presence of this asymmetric carbon atom and the CHOH group in the cholic acid of bile which gives it these same properties.

Every red colony developing on litmus-lactose-agar made up with glycerin, ammonium lactate, or malic acid in addition to ammonium or sodium phosphate was a colony of *B. coli*. On the malic acid plates only red colonies developed and they were all *B. coli*.

The use of these media in water analysis seems most promising. The presence of *B. coli* even in small numbers can be detected by plating large amounts of the water without preliminary enrichment.

The work is at present being extended to the detection and differentiation of *B. typhosus*.

The complete paper is in the *Journal of Infectious Diseases*, 5, 1908, p. 616.

A Synthetic Medium as a Substitute for Loeffler's Blood Serum in the Diagnosis of Diphtheria: F. P. Gorham, Brown University, Providence, R. I.

The proteid-free medium which in the liquid form had been found by Hadley to be favorable for the growth and toxin production of *B. diphtheriæ* was used in combination with agar as a substitute for Loeffler's blood serum. It was as follows:

Glycerin	3.40	parts.
Sodium chloride	0.60	"
Calcium chloride	0.08	"
Magnesium sulphate	0.32	"
Dipotassium phosphate	0.23	"
Ammonium lactate	0.75	"
Ferric phosphate	0.08	"
Glycocoll	0.10	"

Distilled water to make 100 parts, 1.5 per cent. agar, reaction made + 1 with sodium hydrate.

It was found possible to make a diagnosis from swabbings on this medium in less than fifteen hours.

The organisms were of about the same types as on the Loeffler's blood serum, though there was some indication that the granular types were more common on the synthetic medium than on the blood serum.

Note on Roup in Fowls: Philip B. Hadley, Division of Biology, Rhode Island Agricultural Experiment Station.

The present report is based upon the examination of five fowls which died with the characteristic symptoms of "roup." The symptoms and macroscopical pathological appearances were as follows: Onset of disease like simple catarrh; watery exudate from nose and eyes; accumulation of thick mucus or soft, cheesy exudate in orbital sinus, naso-lachrymal canals and palatine space. Walls of mouth cavity and anterior esophagus whitened and necrotic, sometimes punctated with firm, yellowish-white nodules from 1 to 12 mm.

in diameter, and rising from 0.5 to 3 mm. from the surrounding surface; nodules also present in dorsal wall of crop. Esophagus inflamed from crop to proventriculus. Small intestines inflamed and walls thickened, containing mucus mixed with blood. Large intestines usually normal. Ceca inflamed once at necks and once at tips. Liver in two cases contained small white necrotic areas; bile-ducts inflamed and thickened. Kidneys enlarged in one case. Ureters invariably packed with urates, which also fill cloaca. Spleen enlarged in one instance.

The microscopical pathological conditions were studied in fresh preparations, smears and sections. The hard exudate from the orbital sinus was shown to be made up of mucus, coagulated serum and disintegrated cell substance. The soft cheesy matter and the mucus contained numerous epithelial cells, many of which contained coccidia in the schizont or macrogamete stage; these were also found in the free state. Similar bodies were also found in great numbers in the mucus from the naso-lachrymal canals, palatine space, walls of mouth cavity; also from walls of pharynx, anterior and posterior esophagus, dorsal wall of crop, proventriculus, duodenum, bile-ducts, liver, small intestine, large intestine, ceca, contents of cloaca and in the excrement of diseased birds. The encysted stage of the coccidium, which is identical with the organism of "blackhead," was found in the intestines and ceca, but not in the head region.

No bacteriological examinations were made, but it was apparent that the factor, coccidiosis, was sufficient alone to produce nearly all the pathological conditions observed. As "blackhead" is a coccidiosis of the ceca and liver of turkeys, and as "white diarrhea" is a coccidiosis of the ceca, intestines, duodenum and sometimes of the lungs, spleen and liver, of young chicks, so the writer believes that many, and perhaps all, cases of genuine "roup" are instances of coccidiosis of the head region, with or without intestinal complications.

White Diarrhea of Chicks: A Study in Avian Coccidiosis: PHILIP B. HADLEY, Division of Biology, Rhode Island Agricultural Experiment Station.

"White diarrhea" of chicks is a disease affecting the duodenum, small intestines, large intestines, ceca, liver, pancreas, kidneys, spleen and lungs, manifesting itself by inflammation and eventual necrosis of the epithelial, mucosal and submucosal tissues, and terminating fatally in the majority of cases, primarily as the result of damage to the linings of the alimentary tract, and secondarily as the result of bacterial invasion of the tissues together with suspended constructive metabolism. The aim of the present paper is to show the relation of *Coccidium cuniculi* to this disease.

The macroscopical pathological appearances included the following: (1) occasional inflammation of esophagus and proventriculus; (2) inflammation and thickening of walls of duodenum and small intestines; (3) distention and thickening of walls of the cloaca and large intestine; (4) ceca usually inflamed, walls thickened, and containing a hard or soft yellow exudate or "core"; (5) liver usually contained necrotic areas after the thirteenth day of the epidemic; (6) pancreas occasionally greatly enlarged, and having hard cheesy texture; affection of pancreas, liver and duodenum often coincident; (7) lungs frequently congested, containing grayish nodules; (8) heart frequently contained lobular enlargements; (9) kidneys and ovaries enlarged in a few cases; (10) ureters invariably packed with urates (hence the white diarrhea); (11) yolk sac frequently not properly absorbed, yolk stock occasionally inflamed, walls thickened, containing hardened exudate.

These tissues were examined in fresh preparations, smears and sections, and the microscopical pathological appearances were as follows: (1) epithelial cells of the duodenum, intestines and ceca denuded; (2) in these cells, in the mucous cells and also free were many coccidia; (3) coccidia were also found in the large liver cells from necrotic areas, and free in the connective tissue matrix; (4) nodules from lungs revealed marked inflammation and necrosis; epithelium of bronchi and infundibula broken down, and in the cubical and ciliated cells were inclusions which resemble coccidia.

The bodies described above were the schizont or macrogamete stage of *Coccidium cuniculi*, which is also the cause of "blackhead" in turkeys and of some cases of so-called "roup." This stage of the *Coccidium* is probably identical with the *Amœba meleagridis* described by Theobald Smith in 1896. In the present epidemic no permanent cysts were found in birds under one month old. It is thus indicated that the original infection passes at once into the endogenous cycle of development which is maintained for some time before the exogenous cycle appears. The crisis of the

disease is coincident with the formation of the sexual products. The highest daily mortality was reached when the chicks were eleven days old. One month after the beginning of the epidemic 304 chicks had died out of 510. The *Bacterium septicemiæ gallinarum* of Rettger was not found in connection with the present epidemic.

Some Experiences Relevant to the Determination of the Bacterial Content of Milk: Charles E. Marshall, Director, Michigan Agricultural College, East Lansing, Mich.

It is assumed from the observations in the (*a*) Association Studies conducted by the author and Miss Farrand, in the (*b*) Butter Studies conducted by W. S. Sayer, Otto Rahn and Miss Bell Farrand and in the (*c*) systematic work performed by Miss Zae Northrup, all in the bacteriological laboratory of the Michigan Agricultural College, that:

1. Milks vary in their bacterial content as to both (*a*) numbers and (*b*) species.

2. This variation is dependent upon the (*a*) source of the milk, (*b*) method of milking, (*c*) cleanliness in handling, (*d*) temperature maintained, (*e*) etc.

3. Milks in the light of the above can not develop their germ content (*a*) with the same rapidity or (*b*) in the same relative manner, and therefore can not respond *alike* to even ideal or perfect methods of testing.

4. Methods of testing are only incidental to the real problem; they should be employed to indicate and assist in control.

5. While composition of media, means of dilution, time of plating, temperature for plate development and other factors are highly important in the execution of these tests, the most essential factor at this time is uniformity of methods that the variable minor discordant elements may to a large extent counteract each other through the accumulation of evidence.

6. It follows that the purpose of the Committee on Standard Methods of Bacterial Milk Analysis is justified, even though many of its detailed decisions are arbitrary and perhaps unwarranted should uniformity of methods be established.

7. However, much would be sacrificed if laboratory men forgot the real purport of such analyses and used them simply to estimate the milk per se instead of the conditions which are indicated by such analyses.

It is suggested that perhaps more rapid progress would be made and more enduring results secured were the energies of workers devoted to more exhaustive elemental studies which will assist in the solution of some of these problems.

Cremating Furnace for Laboratories: Charles E. Marshall.

It consists of an open brick chimney, lined with fire brick on the inner wall, and with an air space between the inner and outer walls. At the bottom of the chimney are the cremating apartment, the fire box and the ash pit. The essential and valuable feature of the cremating chimney is the using of gas pipes for grates to support the material, thus enabling the placing of a fire below. These pipes are so inserted in collars communicating with the air outside that a cold current of air passes through when heated and passes into the chimney at the inner end of the pipes which rest on a ledge on the inner wall of the chimney.

Published by the Experiment Station Report of the Michigan Agricultural College for 1908.

Preparation of a Standard Solution of Litmus: Chas. W. Brown, Michigan Agricultural College, East Lansing, Mich.

It was found that 2.5 grams of azolitmin dissolved in one hundred cubic centimeters of distilled water would give a solution of such strength that one cubic centimeter when added to one hundred cubic centimeters of milk would give a blue color of the intensity desired for litmus media. With this as a measure, thirteen samples of litmus were standardized, giving the numbers recorded in the table.

Sample	Grams Required to make 100 c.c. of Standard Solution	Per Cent. Insoluble
Azolitmin	2.5	0
Merck's purified	7	2.3
Soluble litmus	8	14.5
Litmus cubes	140	87.1
No. 1	15	44.3
No. 2	32	68.7
No. 3	68	81.4
No. 4	98	89.4
No. 5	128	92.8
No. 6	164	92.8
No. 7	110	91.5
No. 8	154	94.3
No. 9	146	91.7
No. 10	122	91.8

A definite amount of the sample was weighed out and dissolved in a definite volume of distilled water, either by placing in an incubator at 37.5° C. over night or by heating in flowing steam for thirty minutes. The filtrate was compared in Nessler's tubes with the standard solution

(2.5 grs. of azolitmin in 100 c.c. water) diluted one to five thousand—one or two drops of decinormal potassium hydrate was added to each Nessler's tube to bring out the color. From this comparison the number of grams required to make one thousand cubic centimeters of a standard was interpreted.

Variation in the Acidity of Fresh Milk: W. M. ESTEN, Storrs Agricultural Experiment Station, Storrs, Conn.

The extreme variation, of a herd of 26 cows, covering a period of seven months, was from .075 to .23 per cent. The samples of milk were taken about every fortnight. The method of testing the acidity was by titration with $\frac{1}{10}$ normal NaOH, using 17.6 c.c. of milk and dividing the amount of tenth normal by 20. This result gives the per cent. of acidity in terms of the lactic acid molecule. The samples of milk were collected from each cow in the morning from 5 to 6 and were titrated about 10 A.M. In the interval, after a vigorous shaking, 2 c.c. of milk were taken from each sample for the bacteriological test. The experiments commenced on May 16 and extended to December 16. When curves were plotted and drawn for each cow, for different breeds of cows, for averages of breeds and for all the cows collectively, it was discovered that individual cows varied in their own curve and from the curves of the other cows, and that the breeds markedly varied from one another. There was also indicated for every cow a marked decrease in acidity during the summer, and a marked increase during the winter months. The food and seasonal period seemed to be controlling factors in the variation. The eleven Jerseys had an average acidity of .18 per cent., while the Holsteins had an average acidity of .16 per cent. The individual Jerseys showed a larger variation than the individual Holsteins, indicating that the Jerseys are more susceptible to changes and have a more sensitive nervous temperament. The total average of 378 tests on 25 cows was precisely .17 per cent., a value which gives a fairly correct idea of the normal acidity of milk.

Some of the most marked variations in acidity were found among the Jerseys and one Guernsey. One Jersey had an acidity of .13 per cent. at the close of her lactation period and commenced the next with an acidity of .2275 per cent. Three other Jersey cows had acidities of .22, .225 and .23, respectively, as their highest extremes. These cows were apparently in perfect health. It was found that pathological conditions had an effect on the variation of acidity instanced during the summer by a cow with a sore foot. This cow's milk showed a drop to .125 on July 8, a rise to .18 on July 27 and a drop to .135 on August 7. After her recovery her milk acidity rose to .19 and varied afterwards but little. All these results lead to the conclusion that certain factors of food, conditions of health and the change of seasons have their effects, which are shown in the changes of acidity in the milk. A Guernsey had the most remarkable variation of all. Her average was only .108 with variations from .075 to .13. This is the lowest extreme in acidity that has, to the writer's knowledge, been recorded.

The question arises, What are the neutralization elements which we call acidity of milk? Is it the caseinogen alone, or caseinogen combined with other compounds, that causes the reactions? It has been suggested that the amount of acidity is an indirect indicator of the amount of caseinogen present. If this be true the acidity test would be a simple and rapid determination for the approximate amount of caseinogen present. It is to the chemist that we must submit the problem for solution.

Cost of Heating an Incubator with Electricity: W. M. ESTEN, Storrs Agricultural Experiment Station, Storrs, Conn.

There are two important factors which determine the economic application of electricity in the heating of incubators for constant temperatures, namely, the insulation and the heating and regulation devices.

Copper is universally used in constructing incubators for laboratory use. With the exception of silver, copper is the best conductor of heat known. The insulating material used with copper is imperfect and not properly applied for preventing loss of heat. Copper incubators are generally water-jacketed and leaks often arise, causing disagreeable annoyances. The duration of the copper is somewhat limited. If such materials as asbestos, hair felt, wood and cork board are selected and used in combination there can be constructed an incubator, fire proof, with almost perfect insulation, and practically indestructible, at about one quarter the cost of a copper incubator. Moreover, the diminished cost of operation will pay for its construction cost in a few years. The writer has constructed one of these incubators out of asbestos, wood, hair felt and building paper with an inside capacity of three and a half cubic feet, which costs less than one dollar a year to heat to a constant temperature of 37° C.

The thermostat is constructed in the form of a V out of strips of brass and hard rubber firmly fastened together. The coefficients of expansion and contraction of brass and hard rubber are very different. Any change of temperature either opens or closes the electrical contact on the right-hand side of the V. The most important item in the economy of this new style of incubator is that the heat is applied to the interior, where it is used and needed. Incubators heated by gas utilize only about half the heat applied, and there is, besides, the danger of fire in operation.

The most satisfactory heater is made of No. 29 30 per cent. alloy german-silver resistance wire wound on a frame which fits into one end of the incubator. Two frames, one in each end, with 58 feet of wire on each frame and connected as one coil, afford the most uniform method of heating. The wire can be obtained from the American Electrical Works, Providence, R. I. The cotton-wound wire is preferable, for it affords considerable insulation. When the heating coils are completed a coat of shellac on the wire and frames serves as an added insulation. The resistance of the wire is 229.9 ohms per 100 feet. The only current that can be used with satisfaction is the alternating or incandescent type with large volume and low intensity. The voltage should be 110 for the length of wire indicated, which will produce about .4 ampere of current.

Keeping Qualities of Butter—Additional Data: Otto Rahn, Michigan Agricultural College, East Lansing, Mich.

Former experiments have proved that rancid cold-storage butter does not necessarily have free acids—indeed the majority of samples had no increased acidity. It seemed probable that the substances causing the taste and odor of rancid butter come from a decomposition of protein. The organisms which in pure culture are able to make butter rancid, such as *Bacillus fluorescens liquefaciens*, *Bacillus prodigiosus*, *Oidium lactis*, etc., break down proteids easily. The analytical determination of soluble nitrogenous substances, not precipitated by tannin, copper sulphate nor phosphotungstic acid, gave the *highest* increase in the butter sample which scored *lowest*.

Experiments have been carried on to ascertain if unsalted butter did not keep better in cold storage than salted butter. The supposition was that the water and buttermilk of the unsalted samples would freeze, thus preventing any action of microorganisms, while the concentrated brine of salted butter has a very low freezing point. The result was that the unsalted samples did not keep, probably because not all the water was frozen. The unsalted samples scored lower and showed a greater increase of soluble nitrogen.

The only microorganism which multiplied without doubt in cold-storage butter and which occurs in almost every butter sample, is a small *Torula*. This *Torula* is the only microorganism of our butter samples which can develop on agar with 15–20 per cent. salt. A small *Torula* has been found by Rogers in fishy butter. A *Torula* is present almost in pure culture in salted herring and may be the cause of its characteristic taste and odor. The description of the *Torulæ* is incomplete, however, they do not disagree.

Bacillus lactimorbi, Jordan and Harris (nova species)—Its Relation to Milk-sickness and Trembles: E. O. Jordan and N. MacL. Harris, University of Chicago, Chicago Ill.

This organism appears to be a hitherto undescribed bacterium and was isolated by the writers from several cases of trembles in cattle, from one case of the disease in a horse, from two lambs and from four cases of milk-sickness in the human subject. It would seem that the disease in man is incurred through the ingestion of infected milk, milk-products or of meat; in animals by the eating of infected pasturage or by drinking infected water, the contamination of these being from the soil in which the bacterium has its abode.

By means of pure cultures the writers have succeeded in reproducing the essential features of the naturally acquired disease in young rabbits, dogs, calves and one horse; cats and lambs have been infected with the production of pathological lesions, but without any well-defined clinical symptoms.

The organism causing the disease is a strict aerobic, flagellated, sporing, liquefying bacillus about the size of the anthrax bacillus, and very strongly resembling the tetanus bacillus in its most characteristic form. It is, however, very prone to undergo considerable variation in morphology due to methods of cultivation, temperature and fluctuations in reaction of the media being chiefly responsible. Stained with methylene blue the typical tetanus-like bacillus shows well-marked polar metachromatic granules, with at times a central one. It grows either very vigorously or delicately on agar, depending upon whether it is incubated at 25°, 30° or 37° C. Colonies on agar are of a streptococcus type accompanied by a film growth of a delicate nature,

either on the top or on the bottom of the agar surfaces. In glucose agar stab tube no gas is formed and the stab growth is smooth, delicate and whitish. On potato no growth has been obtained, but on Heinemann's synthetic potato medium a so-called "invisible" growth occurs. Broth is moderately clouded and occasionally a delicate surface film is formed. In gelatin the stab extends nearly all the way down the needle-track in a smooth, even manner and of a grayish color; the surface growth is scant, delicate and pearly gray; a saucer-shaped zone of liquefaction makes its appearance upon the surface about the third to the tenth day, and progressively extends outwards and downwards until the whole of the gelatin is liquefied. Occasionally where liquefaction has been delayed feathery outgrowths from the stab have been observed. In litmus milk growth does not readily occur unless the medium has been heavily seeded, then a slow-appearing alkaline reaction makes itself noticeable about the third day at the surface of the medium, which later on extends throughout the tube, eventually rendering the milk semi-translucent; no clotting or proteolytic changes have ever been seen. On Jordan's asparagin medium a well-marked surface film growth takes place with an ultimate slight clouding of the whole medium.

Note on a Lactic Acid Forming Bacillus Closely Resembling B. bulgaricus Isolated from Cornmeal: P. G. HEINEMANN and MARY HEFFERAN, University of Chicago, Chicago, Ill.

During an investigation of yeasts for the preparation of so-called salt-rising bread a bacillus was isolated which, as far as the examination has proceeded, agrees in morphology, staining properties, cultural characteristics and the ability to produce large amounts of lactic acid from milk with the characteristics of *B. bulgaricus*, the organism which has recently received considerable attention and has been recommended by Metchnikoff for the preparation of sour milk. A stain from the mixture of cornmeal, milk, sodium bicarbonate and salt showed a large number of bacilli with the characteristic granular staining of Metchnikoff's bacillus. After cultivation in milk the bacilli stained uniformly. When granules appear the picture recalls somewhat the appearance of small spores and seems to agree with Kuntze's description of his "Körnchen" bacillus. Attempts to obtain these bacilli in pure culture by plating on the ordinary laboratory media failed utterly, but they were readily isolated if cultivated in milk at 37° C. or if plated on milk-agar. The colonies after a few days have peculiar root-like ramifications on milk-agar and may be mistaken for small colonies of *B. subtilis*. In pure culture the milk is coagulated slowly, rarely in less than two or three days. The coagulum is soft and creamy, without the separation of whey, and unlike the more solid coagulum formed by *Streptococcus lacticus*. The amount of lactic acid produced in milk is much higher than the amount produced by *S. lacticus*. After fourteen days 1.65 per cent. acid was determined. By addition of glucose or lactose to ordinary agar a moderate growth appeared after two or three days. If this bacillus is sowed into sterile milk with a culture of *S. lacticus*, acid is formed more rapidly than by either of the two organisms alone and the coagulation of the casein is also more rapid.

Salt-rising bread is started by mixing cornmeal, milk, sodium bicarbonate and salt. It seems that milk is a necessary part, without which probably the bacillus is unable to grow and form the necessary lactic acid for liberating carbon dioxide from sodium bicarbonate. By inoculation of sterilized milk with cornmeal it was ascertained that the bacillus originated from the cornmeal and not from the milk. It is, therefore, quite possible that this bacillus is widely distributed and an investigation is now under way to determine the distribution. We are attempting to isolate this bacillus from a large variety of sources, principally flours, dry fodder, silage, feces of man and domestic animals, sourkrout and other similar substances. The study has extended over a period of a few weeks and we hope to be able to make a more complete report in the near future.

The Gas Production of B. coli: FREDERICK G. KEYES, Brown University, Providence, R. I.

All previous work on gas production has been of little value because of imperfect methods of collecting and analyzing the gases produced.

The ordinary fermentation tube does not give the exact amounts of gas produced because of the solution of the gases in the medium and its diffusion therefrom.

The methods ordinarily used by the bacteriologist for analyzing the gases produced are imperfect because they give merely the CO_2 content and tell little about the other gases which may be present. Also, standard media, even at best, are sufficiently variable to influence materially the amount and composition of the gases produced.

Therefore the writer set about to devise an apparatus which would enable him to collect and

analyze all the gases produced by an organism on a synthetic medium containing substance of known chemical constitution. The results of the use of this apparatus for studying the gas production of *B. coli* are as follows:

	Time in Hours at 37° C.	Total Gas in Per Cent.	CO_2 Per Cent.	H Per Cent.	N Per Cent.
On a synthetic medium in vacuum.	24 72 115	28.6 45.7 96.3	63.36 63.40 63.56	36.6 36.15 35.94	0.05 0.45 0.50
On standard medium in vacuum.	48	197.1	55.87	43.50	0.65

The Utility of the Society's Card in Classifying the Cheese Flora: H. A. Harding and M. J. Prucha, New York Agricultural Experiment Station, Geneva, N. Y.

During the past four years the flora of American cheddar cheese has been intensively studied at the New York Agricultural Experiment Station. In connection with this study an attempt has been made to classify the organisms which were found in nine normal cheeses and so characterize them that they may be recognized by succeeding students.

During the progress of this study there appeared a classification of the bacteria of milk by Conn, Esten and Stocking. This work was of material assistance to us and covered the milk flora so completely that all but one of the organisms found by us in cheese is evidently included under the types described by them. This classification as arranged by Conn is an adaptation to bacteria of the conventional botanical system of classification.

The society's card has also appeared during this interval and the cheese flora has also been arranged in accordance with its system of group numbers.

As the result of this double classification the germs found represent 22 types according to Conn or 33 groups according to the society's card. The classification of the germs found in nine normal cheddar cheeses according to each of these systems is given in the accompanying table. This table is taken from Technical Bulletin No. 8, New York Agricultural Experiment Station, in which are given the details of this study.

The amount of data required to determine the group number and the type name is practically the same, but a careful comparison of the utility of these two systems in connection with this study is strongly in favor of the society's card.

This advantage lies in the increased accuracy with which different workers assign germs to like groups, in the quickness with which such assignment can be made and in the ease with which duplicates can be detected or the accumulated stock of records be consulted.

By the use of the card the results of one worker are made immediately available to succeeding workers and each can recognize the forms which have been already described and build upon the foundation already laid. By accumulating results in this way, it will soon be possible to have as exact a knowledge of the bacterial flora of any given class of objects as we now have of the higher flora of a region.

It is believed that the introduction of the society's card will prove the most important addition to laboratory and classification technique since Robert Koch brought out the gelatin plate.

Autolysis of the Gonococcus: C. T. McClintock, M.D., Ph.D., and L. T. Clark, B.S., from the Research Laboratories of Parke, Davis & Co., Detroit, Mich.

Autolysis of gonococcus cultures has been observed and reported by numerous workers.

The purpose of the present study is: (1) to confirm the results obtained by others; (2) to determine the amount of ferment present, the method by which it breaks up the cells and the extent to which the action can be carried; (3) to determine the effect of the resulting autolysate on the growth of the gonococcus, and other organisms in vitro, and (4) to study the effect of the autolysate on the organisms in vivo and its possible therapeutic application.

The results obtained so far are shown in the following conclusions:

Disintegration or autolysis occurs in gonococcus cultures to a marked degree.

This autolysis can be completely prevented by heat alone at 70° C. for one hour, by heat in the presence of trikrisol at 60° C. for one hour, by 50 per cent. and 95 per cent. alcohol in salt solution and partially by 4 per cent. trikrisol alone.

Specimens stained at certain stages of disintegration show numerous fragmentary cell walls still capable of taking the stain, indicating that the cell wall is not completely disintegrated.

The presence of shadow forms in which the cell wall only is stained indicates that the cell contents are either so changed as to be incapable of taking the stain or have escaped from within the wall.

The presence of soluble proteid substances (as shown by their precipitation with acetic acid) in the surrounding liquid indicates that the contents have escaped from within the cell.

Hence it would seem that autolysis of the gonococcus is effected by rupture of the cell wall and escape of the contents.

The products of this autolytic process markedly inhibit the growth of the gonococcus on artificial culture media. Their use in combating the disease in man will form the subject of a future communication.

A Case of Non-inheritance of Fluctuating Variations among the Bacteria: C.-E. A. Winslow and L. T. Walker, Massachusetts Institute of Technology, Boston, Mass.

Aside from its practical importance, the study of variation among the bacteria promises to throw important light upon some of the fundamental biological problems of heredity and evolution. It is important to distinguish two types of possible variations, those which arise entirely from causes operating within the bacterial cell (either mutations or fluctuating variations), and those which are apparently due to the direct or selective effect of the environment. Goodman[1] has recently demonstrated that by selection of variations of the latter sort the acid production of certain members of the diphtheria group of bacilli may be profoundly modified. In the present investigation the authors have attempted to study the inheritance of fluctuating variations in the paratyphoid group, without special selective action. Cultures of Schottmüller's types A and B were plated out and one hundred subcultures of each were inoculated on ... from separate colonies. A dextrose bro... was inoculated from each streak. The ...roduced were determined by titrating ...ults, when plotted, showed two distinct ... curves of frequency with means ...type A and 1.6 for type B. The agar ...the four extreme cultures (1.1 and 1.6 ... 1.4 and 1.8 for type B), were then ...a series of one hundred streaks made ... The new curves of frequency for these ... reverted completely to the original means of types A and B, showing no inherited effect of the variations exhibited by their more immediate ancestors.

[1] ...of Infectious Diseases, V., 421.

Bacteriology as an Important Non-technical Study: H. W. Hill, M.D., University of Minnesota, Minneapolis, Minn.

Bacteriology is now chiefly taught as an art, of use in some branch of science or industry, and almost wholly for its applications in these. Bacteriology is seldom studied for itself *alone*. But it presents many most important biological lessons, as suitable for the illustration of biological truths as any other biological study now taught; and from the control of conditions possible, some phases of biology can be illustrated best by bacteriology. For sociology, bacteriology permits, as no other biological study does, the appreciation not only of the unit, but of the interrelations of units —and hence furnishes a biological study closely paralleling sociology itself. (As a weapon in the hands of a sociologist dealing with hygienic problems it is of course practically a necessity.) Apart from its academic values its chief practical significance to the non-technical citizen consists in the training it gives concerning the *nature*, *distribution* and *life history* of bacteria and in its *technique*, which teaches the fundamentals of *personal* and *family* defense against disease, as distinguished from the measures of public health or state medicine. For these reasons bacteriology should be taught in the public schools, since diffusion of its teachings through the citizens in general can not be obtained in any other way.

Norman MacL. Harris,
Secretary

University of Chicago

SOCIETIES AND ACADEMIES

THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE

The thirty-third meeting of the society was held at Cornell University Medical College, April 21, 1909, with President Lee in the chair.

Members present: Atkinson, Auer, Burton-Opitz, Elser, Ewing, Flexner, Famulener, Gies, Janeway, Joseph, Kast, Lee, Lamar, Lewis, Lusk, Mandel (J. A.), Meltzer, Meyer, Morse, Noguchi, Norris, Oertel, Park, Pearce, Shaffer, Storey, Terry, Wallace, Wolf.

Members elected: John L. Todd, Peyton Rous, H. S. Jennings, Andrew Hunter, Charles R. Stockard, E. E. Southard, William W. Hale.

Scientific Program

R. Burton-Opitz: The vascularity of the spleen as influenced by single nerves of the plexus lienalis.

Richard M. Pearce: An experimental study of the influence of kidney extracts and of the serum of animals with renal lesions upon the blood pressure.

J. J. R. Macleod: Further observations on the effect of asphyxia and curare on the reducing power of the blood after section of the hepatic nerves in dogs.

William H. Park and Eugene Famulener: Toxin-antitoxin mixtures as immunizing agents.

Alfred F. Hess: Antiperistalsis in its relation to tubercle bacilli and other bacteria in the alimentary tract.

Simon Flexner and Richard V. Lamar: The action of soaps on the pneumococcus.

A. O. Shaklee and S. J. Meltzer: The influence of shaking upon trypsin and rennin and a comparison of this influence with that upon pepsin.

Don R. Joseph and S. J. Meltzer: The influence of sodium and calcium upon direct and indirect muscle irritability and their mutual antagonistic actions.

J. Auer and S. J. Meltzer: The effects of local application of chloride and sulphate of magnesium upon the centers in the medulla compared with those of sodium chloride.

J. Auer and S. J. Meltzer: Respiration by continuous intrapulmonary pressure without the aid of muscular action.

Alexis Carrel: Note on the production of kidney insufficiency by reduction of the arterial circulation of the kidney.

Theodore C. Janeway: A modification of the Riva-Rocci method of determining blood-pressure for use on the dog.

Theodore C. Janeway: Note on the blood-pressure changes following reduction of the renal arterial circulation.

H. C. Thacher: The effect of experimental acute insufficiency of the right heart upon the volume of the organs.

The thirty-fourth meeting of the society was held at the Rockefeller Institute for Medical Research, May 26, 1909, with President Lee in the chair.

Members present: Auer, Beebe, Ewing, Famulener, Flexner, Gies, Hatcher, Joseph, Lee, Lewis, Loeb (Leo), Morse, Meyer (Gustave), Pearce, Shaffer, Sherman, Terry, Van Slyke, Wallace, Weil, Wolf.

Members elected: C. W. Edmunds, J. W. Draper Maury, Adolph Meyer.

By-law Adopted: One of the regular meetings may be held annually outside of Greater New York.

Scientific Program

H. Gideon Wells and Harry J. Corper: Observations on uricolysis, with particular reference to the "uric acid infarcts" in the kidneys of the new born.

L. L. Woodruff: Further studies on the life cycle of paramecium.

W. O. Emery and William Salant: On the decomposition of caffein in the liver.

William Salant: The comparative toxicity of ethyl and amyl alcohol and their effect on blood pressure.

L. B. Stookey: Pentosuria.

Elizabeth Cooke and Leo Loeb: The comparative toxicity of sodium chloride and of fluorescent staining solutions upon the embryos of Fundulus.

M. S. Fleisher and Leo Loeb: The influence of calcium chloride and of adrenalin upon the secretion of urine and upon resorption from the peritoneal cavity.

Benjamin T. Terry: Immunity to various species of trypanosomes induced in mice by the cure of experimental infections.

D. D. Van Slyke and P. A. Levene: On the leucin fraction in casein and edestin.

D. D. Van Slyke: On "Clarin," Vahlen's active principle of ergot.

Daniel R. Lucas (by invitation): Some effects of sodium benzoate.

Matthew Steel (by invitation): An improvement of the Folin method for the determination of urinary nitrogen.

P. A. Levene and W. A. Jacobs: On [illegible] acids.

Gustave M. Meyer and P. A. Leve[illegible] On the behavior of amino acids and glycyl-gly[illegible] its anhydride in the organism of the dog.

I. Levin, D. Manson and P. A. [illegible] nitrogenous metabolism in dogs with [illegible]terostomy.

R. M. Pearce: The depression substa[illegible] urine; its disappearance in experim[illegible] nephritis.

Philip A. Shaffer: Observations on [illegible]olism in a subject of diabetes.

Eugene I[illegible]